FLIGHT

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Editor
C. M. POULSEN

Managing Editor
G. GEOFFREY SMITH, M.B.E.

Chief Photographer
JOHN YOXALL

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The Outlook

A Milestone Moved

THOSE who love continuity in history will not necessarily grieve because the Central Flying School is being moved from its home at Upavon on Salisbury Plain, for that has happened once before. For nine years the C.F.S. was stationed at Wittering, and then it was sent back to its old original home. It is moving again, but only to a spot not far away by air.

What will cause a momentary pang to lovers of tradition is that the name of the institution is being changed. It is no longer the Central Flying School, but has become the Empire Central Flying School. The old familiar initials C.F.S. have lost their historic significance. But, after all, the addition of the word "Empire" (let us thank the fates that nobody has dubbed it the British Commonwealth of Nations Central Flying School) is a gain, not a loss.

The school has changed its function before. In its early days it was the authority which granted "wings" to officers who could already fly. Afterwards, and for most of its career, it has trained flying instructors, which is quite a different matter. Now it becomes a sort of university of war flying, in which the experience gained in all parts of the war fronts will be pooled, and the morals extracted. No doubt the E.C.F.S. will still train instructors, but already there are many schools in the country, and no doubt in the Empire, engaged on that work. One school could not possibly cope with war needs. But a university of air warfare was certainly needed, and the old Central Flying School was undoubtedly the best nucleus round which to found the new institution.

The R.A.F. in Libya

THE public is bewildered by the British defeat in Libya, especially as the Empire held, and still holds, air superiority in that theatre. The fact is that people have come to expect and ask too much from the air. It is a mistake to think that air forces can take the place of ground forces. Certainly the air is a necessary component of any army, and the enemy has often used it most effectively in that way. The Empire Air Force in Libya was not of a kind which could do much to help the Army in its battles. It took enormous toll of the enemy's supply columns, but still enough water, petrol, ammunition, etc., got through to enable the Germans and Italians to press on.

During the last war, a member of the Cabinet remarked that "Jellicoe was the only man on either side who could lose the war in an afternoon." In the desert conflict armour (i.e., tanks) pretty well took the place of the battleships at Jutland, and tanks are not profitable targets for air bombs. It takes a direct hit to destroy one, though a very near miss may cripple one temporarily. In such open country direct hits on swiftly moving vehicles are not common. The "afternoon" of the above-quoted remark occurred on June 13th, when a great proportion of our armour was destroyed by the gunfire of the enemy. From that moment there was no further chance of defeating the Germans until reinforcements reached the Eighth Army, and defeat had to be admitted.

The public is also inclined to confuse air "superiority" with air "supremacy." The latter implies that the opposing Air Force is practically wiped out, as was the Polish force in the autumn of 1939. Air

superiority means no more than it says. In that state of affairs the enemy is able to put up some resistance, and at times to concentrate and gain a temporary and local command of the air at some important point. We have not held air supremacy in Libya since the *Luftwaffe* began to appear on the southern shores of the Mediterranean. Air superiority we still retain.

By the same token, it can now be stated that the fall of Bir Hakeim was not due to the German Stukas, for the Free French lost very few men from air attack. It was the enemy's artillery which made the place untenable, just as it was German guns rather than German bombers which did most of the damage in Warsaw. When artillery can be brought to bear, it is practically always more effective than air bombardment.

What the Eighth Army needed and still needs is more armour and more big guns. At the same time it is hard to avoid the conclusion that its air arm might have been equipped to give it more direct help in the land battles if the matter had been planned and provided for in time.

The Army Glides

AT long last the authorities have lifted a small corner of the veil with which it has been deemed wise to surround everything connected with glider-borne Army troops. The glimpse obtained is not very revealing after all, for it merely discloses the fact, which might have been surmised in any case, that the British Army is interested in the problem of troop transport by gliders, and that pilots to fly those gliders are being trained.

What is less obvious is the reason for training the Army glider pilots on light planes. One would have thought that this was teaching men to run before they could walk, but evidently there have been reasons, and weighty reasons, against doing *ab initio* training on gliders. One may have been the absence of suitable gliders in sufficient numbers, since the Government banned all gliding at the outbreak of war, and the gliding clubs had to be closed down for the time being. But for this fact there would have been no difficulty in obtaining all the gliders and instructors which the Army could have wanted for initial training. But, having lost the clubs and through them the gliders, possibly there was nothing else for it than to train on light planes, after which the pilots have to unlearn a lot of things laboriously absorbed on power-driven aircraft, and become accustomed to the idea that every landing is a forced landing, in the power pilot's sense.

We knew quite early in the war that Germany used gliders for troop transport, and if the Army had not suffered from a total lack of imagination where air matters were concerned, it should have been possible to foresee the possibility that the British Army also might one day, if the war lasted long enough, be wanting troop-carrying gliders and pilots to fly them. Those who strove with might and main to convince the authorities of the desirability of letting at least some of the gliding clubs "carry on" ran their heads against brick walls, and at last, in despair, they had to give up the struggle. The Army has been very fortunate in getting as instructors as many as it has of those who were expert glider pilots before the war.

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NOT IN DOUBLE HARNESS. The two gliders are not being towed by the same aircraft but by one each. The towing cable of a third can be seen running across the foreground. An article on the training of glider pilots appears on p. 7 of this issue.

War in the Air

The Convoy Battle : Our Loss of Cyrenaica : Much Damage to Emden

MR. ATTLEE gave some more facts about the convoy battle in his address to the House of Commons on June 23rd. The eastern convoy, which started from Alexandria, got some supply ships into Tobruk, but did not reach Malta. The Italian fleet cut it off, and the convoy ships used up their fuel in taking avoiding action. So, when it was known that the western convoy from Gibraltar had reached Malta, Admiral Vian turned the eastern convoy back to Alexandria. At the moment it is not clear whether the ships which reached Tobruk succeeded in escaping again, or whether they and their cargoes fell into the hands of the enemy.

Other facts about these fights are well worth putting on record and bearing in mind. The Royal Navy lost one light cruiser, four destroyers, and two escort vessels, all of which were sunk. The Italian fleet which intercepted the Alexandria convoy included the two 35,000-ton battleships, *Littorio* and *Vittorio Veneto*, both of which had previously been damaged by our air torpedoes. An American report had given only one of these as present, together with a battleship of the *Cavour* class. On this occasion one of them was hit by a torpedo, though Mr. Attlee did not say whether that missile was discharged from an aircraft or from a warship. The *Trento* class cruiser was first disabled and set on fire by air attack, and then a British submarine loosed off one or more of the powerful 21in. class of torpedo, and the cruiser went to the bottom. Two enemy destroyers and one U-boat are also known to have been sunk. Other ships were doubtless damaged.

In the two engagements the enemy lost at least 65 aircraft, while we lost 30, some of them naval machines. The western convoy and its escort shot down 43 enemy aircraft for certain and 22 more were probably destroyed, while many more were damaged. The R.A.F. and the Navy are both so scrupulously modest in distinguishing between certainties and probables in air combats that readers may well reckon the 43 probables as dead losses to the Axis.

The R.A.F. Air-Sea Rescue Service at work. Here the rescue launch is seen manœuvring towards a rubber dinghy containing the crew of a Halifax.

With the rescued Halifax crew safely on board, the launch speeds towards its base. Many lives have been saved by the Air-Sea Rescue Service.

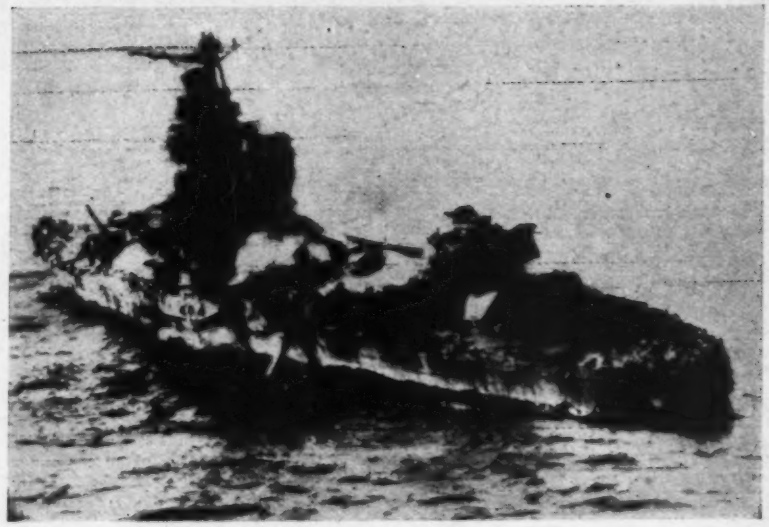
Our Set-back in Libya

ANYTHING like full news about our defeat in Libya is not probable for the present. Some facts, however, emerge clearly even at this stage. The sustained air attacks on Malta did not reduce the island, but they evidently gave the enemy a chance to get large supplies across the Mediterranean to Libya. The majority of the British tanks, apart from the splendid but not numerous General Grants, were outgunned by the heavy German tanks. Ours had mainly little two-pounder guns, which proved useless against the 47-mm. guns in the German tanks. It had been understood that we had starved the garrisons in the Pacific and in India and Burma so as to equip Libya adequately, but we did not accomplish that object. It seems likely that the majority of the heavy tanks which have recently been turned out in Great Britain and the United States have been sent to Russia, and

WAR IN THE AIR

this is not the place to weigh the pros and cons of such a policy.

As for the air situation, it has been set forth many times in these columns that the R.A.F. in Libya was not equipped for dealing anything like decisive blows at the German heavy tanks, and accordingly the policy was adopted of using our air strength to prevent, if possible, supplies from the enemy base reaching the firing line. One need not stress the point that tanks are useless without constant replenishment of their fuel and ammunition, and our policy, therefore, seemed prudent. No criticism can be levied against the squadrons which worked under Air Marshal Coningham. Fighters and bombers did magnificently, and the ground crews in particular had a tremendously hard time in doing constant repairs, as well as refuelling and re-arming, in terribly



NOT SO PACIFIC : The battle off Midway Island lost Japan a large part of her fleet. This picture, radioed from America, shows a Japanese cruiser blazing furiously.

trying conditions. None the less, it has to be admitted that our air policy did not succeed in doing what was hoped. Obviously, Rommel got up enough fuel and other stores to enable him to win a victory. Many hundreds of supply vehicles must be lying wrecked on his desert lines of communication, but the fact remains that his tanks fought on and defeated ours. This Libyan campaign is the one example hitherto in this war in which superiority in the air has not been a concomitant of victory. Evidently air superiority, as a general term, is not enough ; it must be of the right kind—in a land campaign it must be able to help the Army in its ground battles.

Sevastopol

BRITISH thoughts have naturally been so occupied with the tragedy in the desert that they have found it hard to find time to think of other things. Yet, even so, everyone in the Empire and the United Nations has been filled with glowing admiration for the magnificent defenders of Sevastopol. The Germans have been attacking the city now for some weeks with the same fury which they threw into their assaults on Ypres and Verdun in the last war, and with the same disregard of losses on their own side. At the moment of writing it is impossible to guess what the result will be.

At the same time Emden has been subjected to a series of heavy attacks by Bomber Command ; and the place, though not so completely wrecked as Cologne and large parts of Essen have been, has still suffered major damage. It is a port which is useful to the Germans in many ways, and not least on account of its submarine building yards. Photographs taken by R.A.F.

TWO SCENES FROM THE RUSSIAN FRONT : In the upper picture the crew are studying their map before starting on a night flight. The lower photograph shows the bomb-aimer explaining "how he did it."

WAR IN THE AIR

reconnaissance machines have shown that extensive damage has been done to those yards. U-boats have been unpleasantly busy on the far side of the Atlantic, and so these R.A.F. blows to the places where they or their engines are made are no small help in the Battle of the Atlantic. Yet overseas demands for bombers are so great just now that Bomber Command cannot bring all the pressure which it would like to bear on the factory cities of Germany.

Fighter sweeps over France have been kept up continuously, and the Germans dare not diminish the defensive force which they keep in that unfortunate country.

Another 1,000 Machine Raid

A THIRD night raid on Germany by over 1,000 R.A.F. bombers took place on Thursday, June 25th. This time Bremen was the target. The weather was not good, and clouds kept blowing over the target, so that the results could not be observed with accuracy. None the less, there is no doubt that immense damage must have been done to Germany's second largest port, and photographs have already given the Air Ministry a very fair idea of the extent of the havoc, which seems extensive.

Bremen is one of the enemy's principal centres of submarine production, and we may hope that this raid will be followed by a decrease in the number of sinkings of our merchant ships in the Atlantic. The raid itself occupied only 75 minutes, but during the night there were "intruder" operations by other bombers and fighters, which attacked many of the enemy's airfields in the Low Countries. In these operations machines from all the Home operational Commands took part, Coastal and Army Co-operation Commands sharing in the work, as well as Fighter Command.

Forty-nine bombers and three other machines were lost in the night's work, for the enemy's night fighters were up in numbers and attacked fiercely. There were many combats, and our bombers accounted for quite a number of the enemy fighters. *Flak* is also very hot round Bremen, but probably the clouds which partially obscured the target also gave some protection to the British bombers.

BRITISH AIR LOSSES TO JUNE 27th.

	Over G.B. A'crft.	Over Continent B'brs.	Over Continent F'trs.	Middle East A'crft.
June 21	0	1	1	8
" 22	0	6	0	2
" 23	0	2	1	4
" 24	0	0	0	4
" 25	0	49	5	4
" 26	0	0	3	12
" 27	0	9	2	5
	0	67	12	39 (5 pilots safe)

Totals: West, 4,068; Middle East, about 1,328.

The losses are not considered high for a raid of that magnitude, being less than five per cent. of the number of machines sent out. This was the ninty-fifth raid by the R.A.F. on Bremen, but the previous ones must pale into insignificance in comparison.

The night was so short that the R.A.F. raiders took of by daylight on the Thursday evening and did not arrive back at their bases until daylight on the Friday morning.

A raid on a small scale was made on the Midlands and East Anglia on the night of June 24th. Five raiders were shot down.

The Battle of Egypt

THE Eighth Army has withdrawn from the frontier of Egypt, and the first clash with the advancing German columns took place along a line with Mersa Matruh as its northern extremity. The R.A.F. did its utmost to harass the enemy as he advanced, and after furious assaults on his supply columns, it turned to actual attacks on his troops. The squadrons went in for ground-strafing by day and bombing from high and low levels by night. Fighter-bombers have proved very useful in the recent engagements.

The Empire bombers raid behind the enemy front every night, just as the Germans and Italians bomb our troops. Of course, now that our flying fields have to be farther back, our machines have longer flights to make when they attack the ports now in the enemy's hands. It would be most helpful to the Eighth Army if our bombs could put those ports completely out of action, but it is a very difficult matter to wreck a port to that extent. We have proved that by the raids made by our home-based bombers on the harbours of Northern France; and we have also proved that the ports in Great Britain could continue to do their duty even at the height of the German "blitz" on Great Britain over a year ago.

The Middle East's air strength has been reinforced, and the process goes on. The arrival of more American bombers was very welcome, even though the R.A.F. has a preference for the home-made article. This *drang nach osten* of British-built bombers has its repercussions on the activities of Bomber Command. If every bomber turned out by a factory in Great Britain were available for use by Bomber Command, the scale of our attacks on German industrial cities would soon be multiplied. But the Middle East is still our second front, and it undoubtedly relieves the pressure on the Russian armies.

Squadrons of American Army bombers have been arriving in Great Britain, and more are to come.

ENEMY AIR LOSSES TO JUNE 27th.

	Over G.B.	Over Continent	Middle East
June 21	3	2	6
" 22	1	0	2
" 23	1	4	2
" 24	5	0	8
" 25	0	3	3
" 26	3	1	9
" 27	1	3	17
	14	13	47

Totals: West, 6,025; Middle East, over 4,060.

CO-OPERATION: Army and R.A.F. personnel working together refuelling and reloading a Spitfire on a Malta airfield.

HERE AND THERE

Munition Merger

IN order to co-ordinate more closely their activities, it is proposed to merge into Vickers-Armstrong, Ltd., three of their subsidiary companies, namely The Whitehead Torpedo Co., Ltd., The Thames Ammunition Works, Ltd., and the Variable Speed Gear, Ltd.

"Happy Landings"

THERE are programmes for the Navy, programmes for the Army, and programmes for almost every Service, and an A.C.2 wrote to the B.B.C. some time ago and asked why couldn't the Air Force have its turn, too? The result of his application was heard on July 1, in the Forces programme, when Ronald Waldman produced "Happy Landings."

"Happy Landings" was a variety programme provided by the cream of the professional talent now serving in the R.A.F., with a guest star from the Navy and another from the Army. The programme was written by R.A.F. men, and the music provided by the Squadronnaires Dance Orchestra conducted by Sergeant Jimmy Miller, and the arrangements made by P/O. Peter Yorke.

Flt. Lt. Richard Murdoch ("Stinker" of "Band Waggon" to you) appeared in "Happy Landings," together with many other famous variety stars now serving in the R.A.F. The show was given in a London theatre, before a large audience composed entirely of R.A.F. personnel.

HE DID PLENTY! President Roosevelt pins the Congressional Medal of Honour on Brig. Gen. James Doolittle, who led the American bombers on their daring raid on Japan. On his left is Gen. H. H. Arnold and Mrs. Doolittle, and on the right, Gen. G. C. Marshall, U.S. Chief of Staff.

First Cingalese Fighter Pilot

CEYLON has joined the list of countries which have supplied fighter pilots to the R.A.F.

A 21-year-old Cingalese is now serving as a sergeant pilot in a Spitfire squadron which is regularly engaged in offensive operations over Northern France.

Born in Ceylon, the sergeant lived for some years in Malaya, where his father was a prosperous merchant in Kuala Lumpur. He joined the R.A.F. in Singapore, and was sent to Canada for his initial training.

He reached England some time ago, passed through an operational training unit, and was recently posted to his present squadron.

Generous South American

CHILDREN of employees at Rootes' factories in this country have a kindly patron in Mr. Norman Coates, of Montevideo, who recently sent a large donation towards the cost of tea parties for them.

In a letter to Sir William Rootes, Mr. Coates said the donation was a token of appreciation to the war workers, to whose children he would like to give some small pleasure.

A prominent business man in Montevideo, Mr. Coates' family left England to make their home in Uruguay many years ago, but his elder son returned to this country to join the R.A.F.

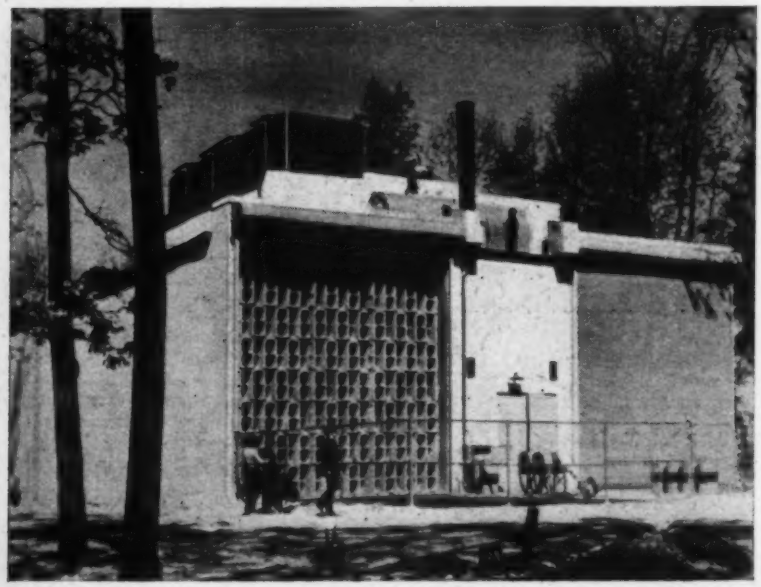
Mr. Coates (sen.) has previously made generous contributions to the Lord Mayor of London's Fund, and is president of the English Club out there, which has sent handsome donations to various distress funds in Great Britain.

Air Scout Exhibition

A THREE-DAY exhibition was held last week-end in the Fulham District Boy Scouts' headquarters by "The Mohicans" 20th Fulham Air Scout Group, to which admission was free by ticket.

In addition to the general public, parents and members of school staffs, the A.T.C., Cadet Corps and other youth organisations and the Home Guard were specially invited.

A considerable number of visitors attended this well-arranged little air exhibition which demonstrated the activities of the Air Scouts, and which also included a display of *Flight* identification charts of British, American and German aircraft, and eight photographic enlargements of aircraft and aircraft engines.



ENGINE LAB. This engine-airscrew research section is part of the $18,000,000 N.A.C.A. laboratory nearing completion at Cleveland, Ohio.

GLIDER TRAINING

Army Pupils : R.A.F. Instructors : A Visit to the Glider Training School

By MAJOR F. A. de V. ROBERTSON, V.D.

A Royal Air Force instructor explains the controls to an airborne soldier. Note the good forward view obtainable, and the nearness to the ground, both of which facilitate the approach and touch-down.

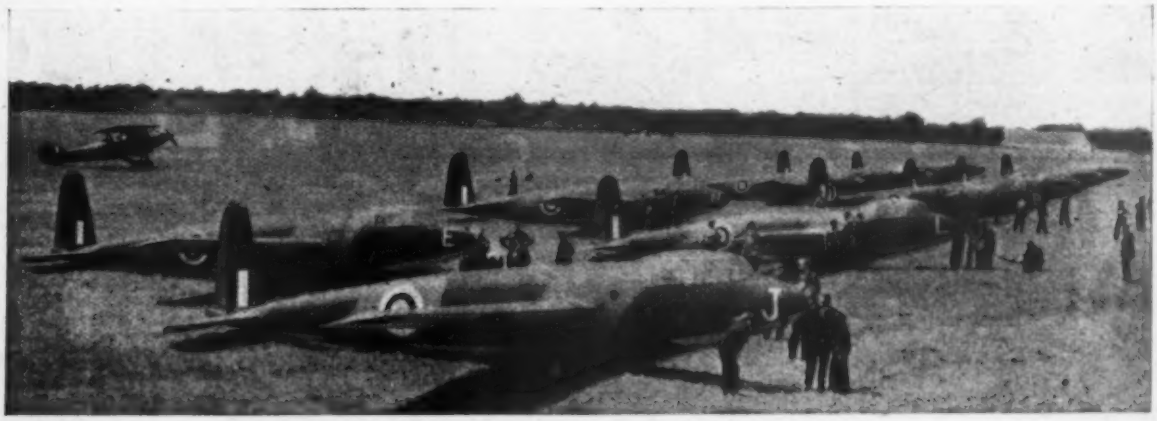
OF late there has been much talk about a second front in Europe —in fact, Mr. Hopkins said that if necessary there would be third and fourth fronts. That prospect inevitably brings to mind the chance of using air-borne troops. There is nothing secret in the idea ; the enemy has used such troops on a number of occasions, and sometimes with considerable effect. The British have once dropped parachutists in Southern Italy, and when the time comes to establish a second front in Europe the Germans will be expecting numbers of British and American soldiers to arrive by air. In fact, it was announced not long ago that officers and soldiers of the Army would be trained as glider pilots in preparation for such action. It was also announced that the training of Army glider pilots would be entrusted to the R.A.F. That was, of course, the only sensible course to take, and so Training Command has taken charge of the business and got it into working order.

Soldier and Airman, Too

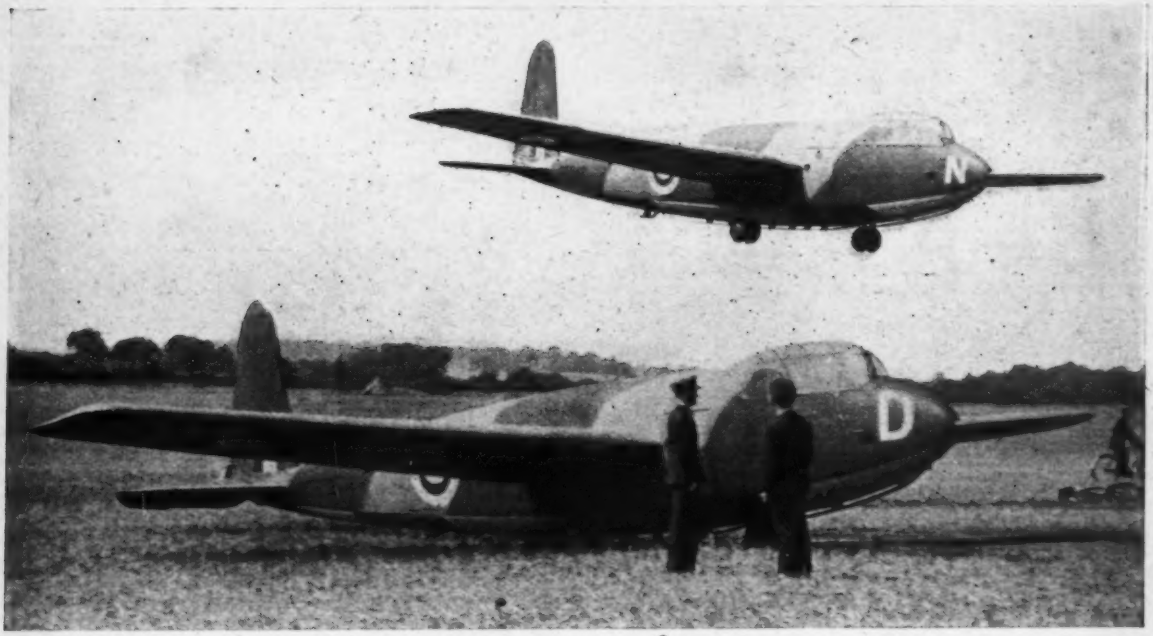
There are good reasons why the glider pilots should be members of the Army rather than of the R.A.F., though at first sight it might seem that it would have been a simpler matter to let the R.A.F. provide the pilots. But when air-borne troops are landed it is usually the intention that they should stay put in the country in which they have come to earth. It would usually be impossible, even if it were desirable, to evacuate them by glider. Therefore the moment that the glider has landed the pilot must obviously become a soldier, trained to fight on the ground. It would be a wasteful proceeding to send an R.A.F. pilot on such a mission, not that it would be impossible to teach him to fight on the ground, but because his training in the R.A.F. has been more elaborate and he is of more value to his own Service than he could possibly be to the Army.

The course of training of an Army glider pilot is as follows. It may seem strange, but it is a fact that Training Command has decided that the best way to start off a glider pilot is to teach him to fly a light power-aircraft. That theory is not in accordance with the practice of the civil gliding clubs which led such an enthusiastic existence in the latter years of peace. It was then often preached that the ability to fly a glider would be a most useful preliminary to the training of a pilot of a power-driven machine. However, Training Command has decided to work in the reverse direction, doubtless for very excellent reasons. For one thing, the organisation for training what we may call normal pilots already existed, and could be utilised ; and, after all, it is a fairly straightforward business to teach an ordinary fit man to fly with an engine in front of him.

The future glider pilots of the Army are all volunteers for the job. Some are officers, but the majority are "other ranks," and they mostly come into the hands of the



A line-up of the school's equipment. This type of glider is known as the Hotspur.

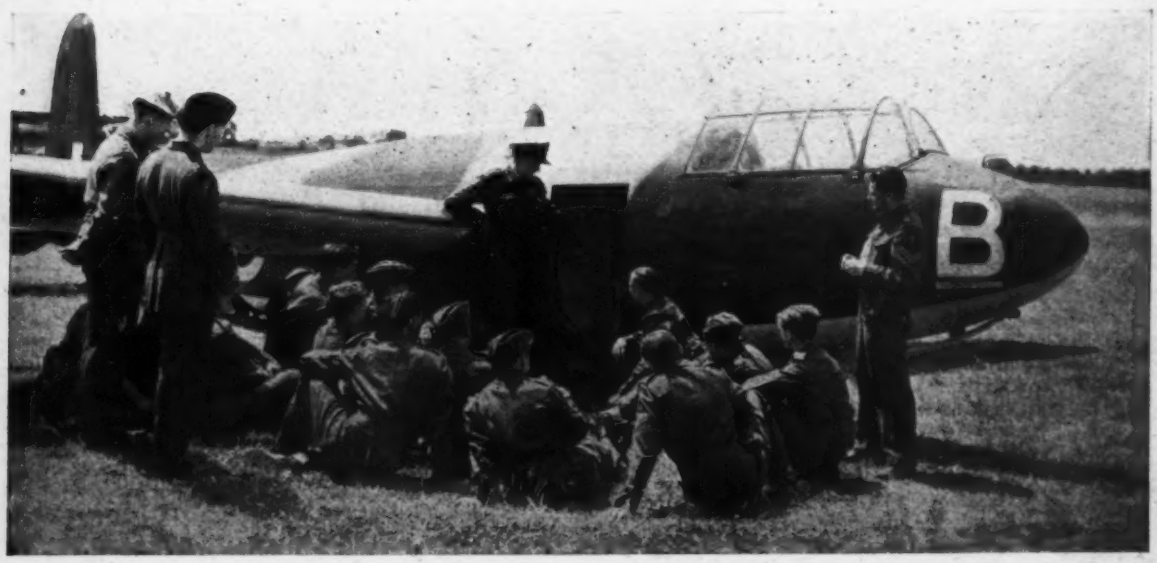


Airborne and grounded. In the air the gliders look pretty, although the undercarriage spoils the clean lines somewhat. The glider on the ground gives a good idea of size.

R.A.F., with the rank of corporal. After being awarded their "wings" at a Glider Training School the corporals and all non-commissioned personnel are promoted to sergeant. These volunteers may come from any branch of the Army, and after being accepted for training they are drafted into an Air-borne Division. First of all they go for a course to the headquarters of that Division which teaches them what it is thought necessary that they should know about theory of flight. While there they remain on the ground.

The second step is to send the men to an Elementary Flying Training School, where they learn to fly light power-driven aircraft. At this stage any men who do not seem likely to make good pilots are weeded out, but the number of duds is small. In consequence, very few have to be rejected at a later stage. It follows that at the end of the war there will be in the Army a useful number of men who can fly, not only gliders but also power-aircraft. If they remain in the Army they may be very useful to it, for the possibility of the Army one day possessing its own Air Arm cannot yet be ruled out. If they accept demobilisation they will swell the number of civilians who are something more than merely air-minded, and that, too, will be to the advantage of the population.

The third stage for the trainees is to go to a Glider Training School, and it is with that stage that the present article is mainly concerned. The men undergo a conversion course from power machines to gliders. The gliders are of the troop-carrying class, though naturally at the school ballast is used instead of live soldiers. The gliders all have dual control, and, as there is no engine noise to deafen the ears, it is easy for the instructors to talk freely to



An open-air lecture by an R.A.F. instructor to his Army pupils, who will later become pilots of troop-carrying gliders.

GLIDER TRAINING

the pupils. The instructors are all expert glider pilots who have joined the R.A.F. Some are officers and the rest are sergeants. Some of their names were famous in gliding circles, and indeed throughout the country, before the war for having made outstanding flights, either of extraordinary duration, of unusual altitude, or of remarkable distances covered. The pilot who took me up for a flight in a glider during my visit to the school had achieved a record for Great Britain a few years before the war. He wore spectacles, which are not usually seen on a man with pilot's wings—but what of that? His outstanding ability had been amply proved.

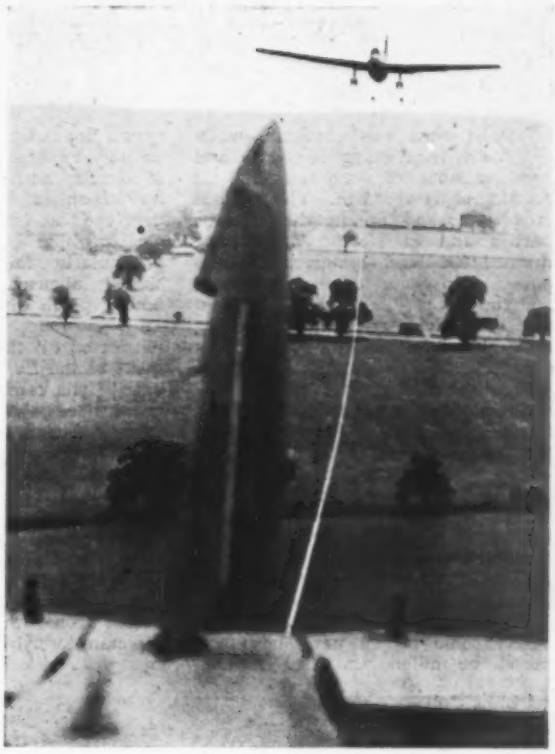
Two main things have to be learnt at these schools. First, the man must learn to fly on tow, which is not just as easy as guiding a towed motor car. In the second place he must learn to be unerring in making his approach and landing, for if the pilot of a glider misjudges, he gets no second chance. In addition, a certain amount of night flying is done at the school.

The Later Stages

The next stage is with a Glider Operational Training Unit, and there the pilot, now adorned with "wings" of a special pattern, which includes a golden lion, does more dual, especially when he takes up real troops for the first few times. He flies the same training type of glider with which he had become familiar at the G.T.S., but he makes wider use of it, landing on strange fields, doing more night flying, and also enduring long tows of about 150 miles. This last is quite an exhausting ordeal. One imagines it would also be very boring for the troops inside the fuselage. In short, the pilot learns to use his glider, which previously he had only learnt to fly.

Finally, the pilot goes back to his own Service, the Army, and is employed as the Air-borne Division thinks best. He is made familiar with different parts of the country, and works with various categories of troops.

At the G.T.S. it is fascinating to watch the routine. The power machines, known as the "tugs," are flown by ordinary R.A.F. pilots, and they find their job most monotonous. They deserve sympathy, and also admiration, for they do good and necessary work. After the glider pilot has dropped his end of the towing cable, the tug has to fly round and drop the whole cable on a certain part of the flying field, where a trailer picks up all the cables. They are then tested and rewound on drums. When a glider has landed, a caterpillar tractor rolls out to it and tows it back to the starting line.



Hectoring a glider might be an appropriate title for this picture, taken from the "tug."

When I was there a fine display of formation flying by six tugs with gliders was given, the whole effect being something like a cat's cradle. The six tugs took off in line, but soon changed to very correct echelon. The gliders kept slightly above the slip-stream. To a passenger in a glider the motion felt rather jerky until all the cables were cut off simultaneously at the firing of a Very light. After casting off the tows, three of the gliders made a sensational dive, disappeared behind a hedge, and then hopped over the hedge to land in perfect line. The other three made a normal gliding approach. It was a most impressive display.

A caterpillar tractor is used for towing the gliders to their starting point.

BEHIND THE LINES

Nazi Labour Famine : Industry's Wholesale Advertising in German Press for Skilled Men

THE Nazi war machine, while still functioning efficiently and capable of vast outputs, is showing signs of strain. The millions of men locked up in the Russian battles and in North Africa have drained the Nazi resources of manpower. To these figures one should add the troops, Gestapo and S.S. engaged in policing the subjugated countries, in spying on the civilians, in executions, prisons, and the 1,500,000 Germans tied down to passive and active defence against R.A.F. raids. Germany is bent on developing the production resources of conquered Europe, and she needs skilled men, organisers, engineers, to do so. But what is perhaps even more important, for fear of sabotage, she cannot rely on local labour, and is thus forced to send experts—slave drivers—to the conquered countries.

Thus the Nazis are in a vicious circle. The people have been promised the millennium when the conquests are completed. Instead, more than ever before do their armies bleed in Russia, and the newly "opened-up" countries of Europe cannot be developed at full speed.

Meanwhile, German industry itself, particularly those industries where skilled labour is essential, feel the double pinch of the situation. They *must* keep up, if not increase, their output to fill the gaps in the equipment of the *Luftwaffe* and the army, and at the same time they find the problem of labour is getting increasingly difficult. Slave labour is to step into the breach. From Holland, Belgium, France, Poland, Hungary, Spain, and even Italy, over 2,000,000 "volunteer" workers have been drafted, lured or cajoled for employment in German factories. *There* they are far less dangerous than in their own countries.

But even with this slave drive, the German industry faces an acute, if not yet critical, shortage of manpower. While all belligerent countries must, under conditions of modern industrial warfare, feel the pinch of labour shortage, Germany's situation is even more acute and dangerous. For the Nazis have made the world believe in their efficient and supreme organisation for the war effort. While no one can reasonably doubt the efficiency of the Nazi war machine, it appears that the organisation of the labour force is lagging behind. For if every able-bodied German is allocated his place in the war effort, how is it that the German Press displays pages and pages of advertisements of firms seeking labour, scientists, technicians, physicists, designers, etc.?

Were their mobilisation of the available skill as thorough as one was inclined to imagine, every German would, after three years of war, have been placed in industry, and the present frantic search in the newspapers would be pointless.

NOT SO EFFICIENT: Just a few of the many pages of advertisements in the German Press asking for skilled workers of all kinds, and promising advancement to technical college students.

EVOLUTION of the GERMAN FIGHTER

Camouflaged Experiments with Earlier Types : Some Single-seater Biplanes : Goering's "Mutual Benefit" Activities : Messerschmitt Monopoly

By V. L. G.

THE development of German fighter aircraft, culminating in the recent appearance of the Focke Wulf 190 in the skies of Europe, goes back to 1929. In those days the Germans were producing, officially, only sport and commercial types, but had been secretly busy on the design and development of military types. While this had been consistently denied by them, they now openly admit it. Under the camouflage of peaceful intentions, experimental types were built and foundations laid for the time when the production of military aircraft could appear in the daylight. In 1928 Heinkel produced the He 37, in 1929 the He 38 and 1931 the He 43 single-seater biplanes, which were camouflaged fighter types and could have been used for military purposes. Next to Heinkel it was the "Arado-Werke" which were quietly engaged on the development of fighter types and produced a biplane designated *Arado* 64.

Goering's Role

In these efforts of the German aircraft industry to produce, secretly, military types, Hermann Goering, then member of the Reichstag, played an important, if not an altogether altruistic, rôle. Privately subsidised by aircraft firms, Goering was to foster their demands and to convince the powerful leaders of the Reichswehr as to the necessity and urgency of allocation of money from the secret military budget for the construction of experimental types of military aircraft. While the personal benefits so derived helped Goering through a difficult financial period, it must be said to the credit of the Reichswehr leaders that they fully appreciated the importance of aircraft in the secret rearmament of Germany.

With the advance of the Nazi régime in 1933 a new impetus was given to the production of military aircraft. In 1933-34 the Arado produced the Ar 65, which was to be the "corner stone" of further developments of German fighter aircraft. The Ar 65 was the first aircraft produced in series for the *Luftwaffe*. It was a robust biplane, built of mixed construction, with a fixed, covered undercarriage. The Ar 65 was powered with a B.M.W. VI in-line engine of 600 h.p and had an armament composed of two fixed machine-guns. It was capable of a speed of almost 300 km/h. It was this aircraft which formed the main equipment of the "Richthofen Squadron" of the *Luftwaffe* after its recreation by the Nazis.

With orders rapidly coming in, it was possible for the Arado Company to turn out the fighter in series production as well as to arrange with other aircraft firms for building under licence agreements. Thus favoured by the Government, the Arado produced the little-known Ar 67, a prototype powered with a Rolls-Royce Kestrel engine, from which a further type, the Ar 68, was developed. There were two versions of this aircraft, the Ar 68E and 68F, powered with either B.M.W. VI engines or the new Jumo 210, and both were built in serial production.

BACK ROOM BOCHE : Kurt Tank, the designer of the Focke Wulf Fw 190, the latest addition to the *Luftwaffe* fighter squadrons.

At the same time Ernst Heinkel produced another fighter, the He 51, the second fighter aircraft produced by this firm, which was very much like the Ar 68 and was also put into serial production.

Both types of aircraft formed the main equipment of the *Luftwaffe* fighter squadrons until the beginning of serial production of the Me 109, about 1937-38. During the Spanish civil war the Ar 68 and the Heinkel 51 were extensively used by the "Condor Legion," and the experience gained under conditions of real combat has been applied to the development of later fighter types. It is mainly due to the conclusions drawn from these experiments in the "Spanish laboratory" that the future policy of fighter development was definitely decided in favour of the all-metal low-wing monoplane.

At that time, 1937, the German aircraft industry switched over from the biplane to the serial production of monoplanes. But, actually, the origin of the German monoplane fighter dates back to 1934, when it was realised that the monoplane with a retractable undercarriage was the future type of fighter. In the development of this type particular attention was paid to the possibilities of series production, which was considered to be of primary importance for effective supply.

The results of these efforts were the Me 109 and the Heinkel He 112, first completed in 1936, which were to become later the main basis of the *Luftwaffe* equipment. But Messerschmitts and Heinkels were not the only ones responsible for the development of the new monoplane fighter. The work of the designing offices of other firms, with their different experimental types of which the outside world knew hardly anything, were pooled in the final construction of the new fighters.

The Focke Wulf Fw 159, produced in 1934-35, was an early ancestor of the Fw 190. It had a retractable undercarriage.

EVOLUTION OF THE GERMAN FIGHTER

Among them was the Focke Wulf Fw 159, first constructed in 1934-35, a high-wing monoplane, with a retractable undercarriage; another type was the Arado low-wing monoplane Ar 80, with a fixed, faired undercarriage. Both were all-metal machines with a speed of about 400 km/h, and were the strongest competitors to the Me 109 and He 112. Finally, considerations of production (easier and faster output in series) tipped the balance in favour of a monopoly for the Me 109, while some aspects of the Fw 159 and the Ar 80 were embodied in the new design.

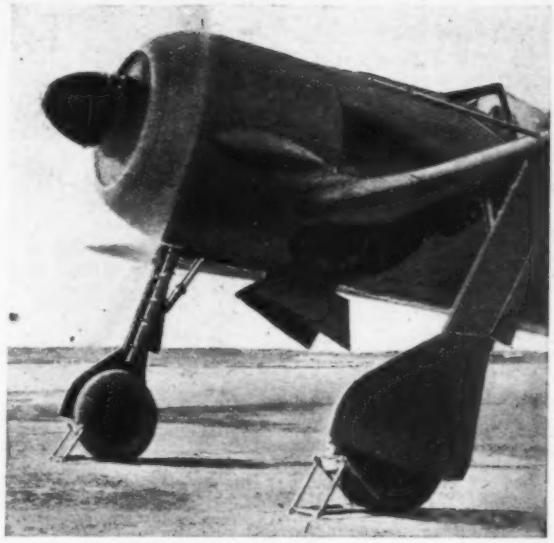
From 1938, when the Me 109 was being produced in substantial numbers, German designers concentrated on the development of a heavy twin-engine fighter. The Messerschmitt works again scored in the competition against other firms with their Me 110, and it was this type which first came into serial production. But it should not be overlooked that the Focke Wulf were also active in this field and produced the Fw 187.

Gaining Experience

Although the latter has only been built in small batches, the work of this concern contributed substantially to the equipment of the *Luftwaffe*. For it is the experience gained by the construction of the Fw 187 which has enabled that firm to produce Germany's latest fighter, the Fw 190.

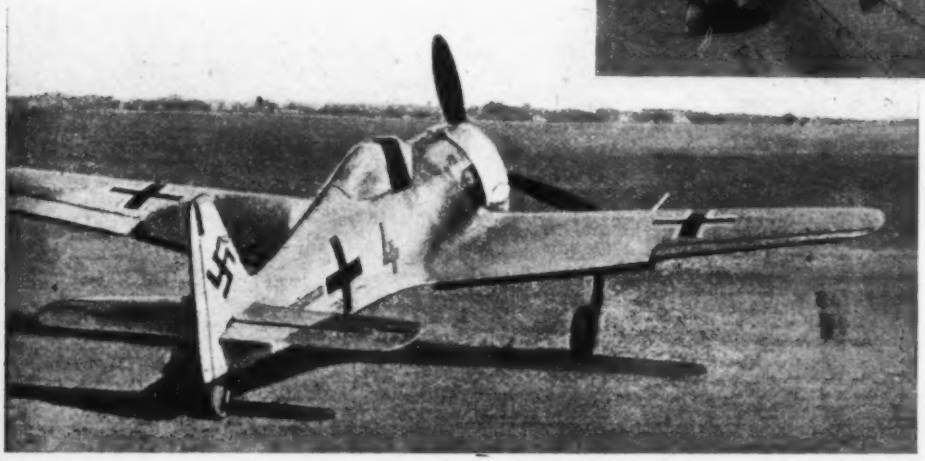
Early this year this fighter made its first appearance, if only a modest one, in the skies of Europe. Later on, in the spring, Fighter Command aircraft engaged on sweeps across the Channel met increasing numbers of the Fw 190, and shot down substantial numbers of them. Pictures and descriptions of the Fw 190 were published in *Flight* of May 14th, 1942. The fighter was designed by the Armament Industry leader (Wehrwirtschaftsfuehrer) Kurt Tank, the creator of the Focke Wulf Fw Condor and the short-range reconnaissance aircraft Fw 189. It will be remembered that the new fighter is powered with a B.M.W.801 14-cylinder, two-row air-cooled radial engine of 1,600 h.p. The top speed of the aircraft is somewhere in the region of 370 m.p.h. at 18,000ft., with a range of 500 miles at a cruising speed of 300 m.p.h. German reports state that the Fw 190 is equipped with a mixed armament composed of machine guns and cannons.

It is quite likely that the Fw 190 is not the final stage of development of German fighter aircraft. But with the terrific strain on their production resources, in particular that of the skilled labour, it may yet be some time before the *Luftwaffe* squadrons receive a new range of equipment. Yet there is no doubt that the Germans will spare no efforts to maintain a relative parity in the quality of their fighter aircraft with the increasing and improving production of the Allies.



COMPACT POWER: This close-up of the nose of the Fw 190 gives a good idea of the neat installation of the B.M.W. two-row air-cooled radial engine. Note also the wing recesses for the wide undercarriage, and the lightweight chocks.

(Above) A final word with the pilot of a Fw 190 before he takes off. The large "V" is already lying down!



(Left) A rear view of the Fw 190 which accentuates the slim section of the fuselage.

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AIRCRAFT TYPES AND H

Heinkel He IIIK and Ju 88 Bombers

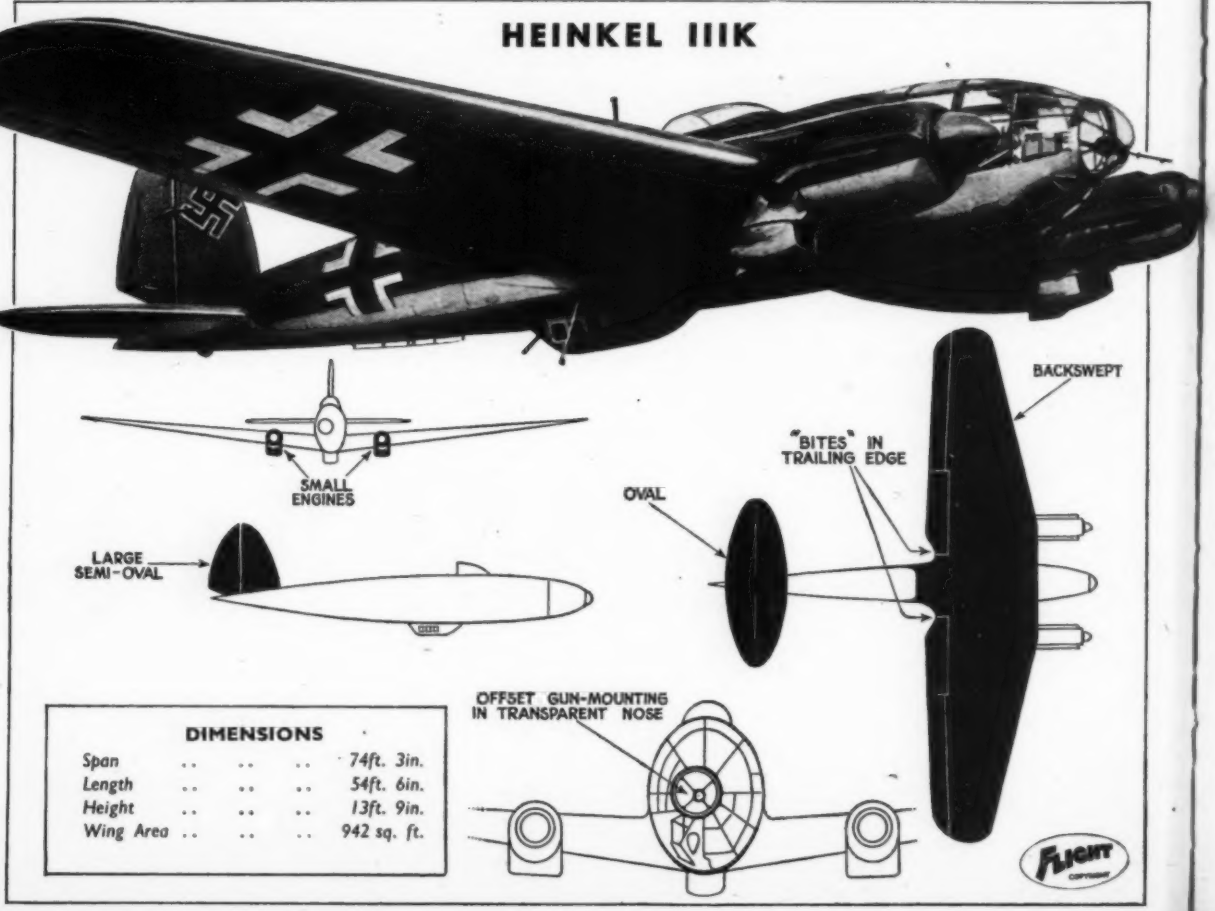
IN accordance with Germany's traditional cunning, there appeared towards the end of 1935 a fast and nicely streamlined 12-seater airliner in the shape of the Heinkel 111. This new "commercial" aircraft was powered by two 660 h.p. B.M.W. VI engines and had a top speed of 212 m.p.h. In January of the following year it went into service on the *Deutsche Luft Hansa* routes. But that the type had been designed with more than half an eye on its military potentialities became clear very soon afterwards when a Mark II version, equipped with two Daimler-Benz 600 engines, having a maximum speed of 233 m.p.h., suddenly went into production for the *Luftwaffe*.

The Mark IIA, with DB 600 G power units, saw service in Spain, and this had a top speed of 252 m.p.h. Then came the Mark III with Jumo 211 engines and a further slight improvement in performance, and in 1937, when the DB 601 engine became available, there appeared the Mark IV with a top speed of 261 m.p.h. at 12,300ft. This was the last of the long-nosed Heinkels, and in 1938 production began on the Heinkel 111K, Mark V, with a shortened nose in which the pilot's cockpit was sunk, the latest edition of which has the nose gun-mounting slightly offset to the right.

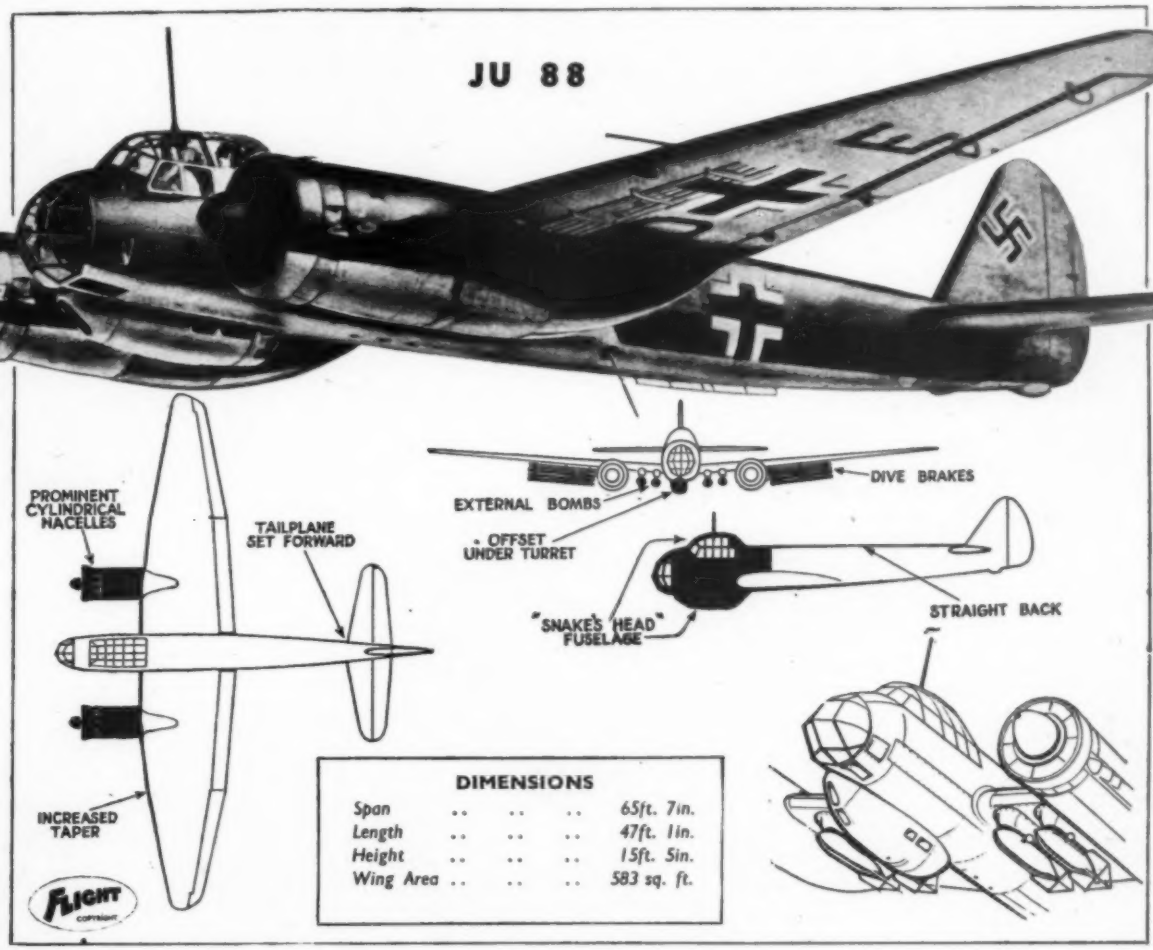
The current Mark V type is powered by two Daimler-Benz DB 601A engines, each giving a maximum output of 1,150 h.p. at 2,400 r.p.m. There is also the Mark VA with Junkers Jumo engines with a slightly increased individual maximum power output of 1,200 h.p. The former version has a top speed of 274 m.p.h. at 12,300ft., and cruises at 230 m.p.h. at 13,120ft. Its service ceiling is 24,100ft., and its normal cruising duration is 9.5 hr., which gives a range of 2,140 miles on a tankage of 880 gallons of fuel. With an overload of 1,100 gallons, however, the duration and range at cruising speed are increased to 12 hr. and 2,640 miles respectively.

The fuselage of the Heinkel He 111K, Mark V, is an all-metal structure of oval section. It has Z-section frames and top-hat section stringers. The wings are of all-metal two-spar construction, and the tail unit is also a metal structure. Flush-riveted, stressed-skin covering is used throughout except for ailerons, elevators and rudder, which are fabric-covered. Camber-changing flaps are fitted.

The defensive armament of the He 111K is anything but heavy, and as it was the chief type used for raids on this country, it has suffered considerable losses under the guns of the R.A.F. Fighter Command. It mounts six machine guns, all manually operated. There is one flexibly mounted gun in the offset nose blister, one above the fuselage in a shielded position, two in a faired emplacement below the fuselage, one of which fires forward and the other aft, and port and starboard guns on flexible mountings firing through side windows. All machine guns are of 7.7 mm., but the substitution of cannon in some instances is an obvious possibility.



HEIR CHARACTERISTICS



AS the Junkers Ju 88 did not go into production until early in 1939, it was not necessary even to pretend that it had been designed as anything but a war machine. Its immediate predecessor, the Ju 87, had also been avowedly a fighting machine, whereas the Ju 86, like the Heinkel 111 and others up to 1935-36, had all come into being ostensibly as civil airliners, though designed with a definite vew to ready conversion into military aircraft.

Great Britain, on the other hand, with a futile sincerity in her policy of international disarmament, designed her civil aircraft with the sole object of peaceful passenger- and freight-carrying, such machines as the Sunderland being adapted under the stress of urgency.

The Ju 88 is probably the most aggressive-looking fighting machine that Germany possesses, and it is certainly one of the most useful. It went into production early in 1939 (soon after production was stopped on the Ju 86), and it jumped right into aviation's limelight by almost immediately setting up an international record in the hands of Ernst Siebert and Kurt Heintz. With a load of 4,400 lb. it flew the 620 miles from its native Dessau to the Zugspitz Mountains and back at an average speed of 320 m.p.h. This was, of course, a specially prepared machine, and a few weeks later a similar model, carrying the same load, clocked 311 m.p.h. over a distance of 1,240 miles.

Designed originally as a high-performance bomber, it was later modified into the dive-bomber we now know, a process which entailed some strengthening of the structure and the addition of dive-brakes to the wings. The armament was also increased, and although primarily a replacement type for the "Stuka," the Ju 88 can be, and is, used for normal bombing as well as for dive-bombing. It has been the chief type used for attacks on Channel shipping, and took an appreciable share in the raids on London. An interesting refinement on the latest "A-6" model is an automatic device for pulling out of a bomb-dive and closing the dive-brakes at the right moment in relation to the release of the bombs. The complete sequence is operated by pressing one button.

The all-metal monocoque fuselage crowds the crew of four into the small space of the "snake's head"; the two-spar wings are hinged along the entire trailing-edge, the outer portions acting as ailerons and the inner ones as landing-flaps. Like the fuselage, the wings are stressed-skin covered and flush-riveted. The tail assembly is also a metal structure with flush riveted stressed skin on the fixed areas, but has fabric-covered fin and rudder.

The two Jumo 211 engines each give 1,200 h.p. and, although they are 12-cylinder in-line units, their circular nose radiators give the appearance of radial installations. The top speed (without external bombs) is 281 m.p.h. at 16,000ft., cruising speed 264 m.p.h., and diving speed with brakes is up to 340 m.p.h. and over 400 m.p.h. without them. Service ceiling is 29,800ft., cruising range 1,310 miles, and bomb-load 2,500 lb. Six machine guns form the defensive armament; one in the nose, four in the rear cockpit, and one rearward-firing gun in the offset gondola beneath the fuselage.

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WORLD PRESS SUMMARY

RÉSUMÉ OF TECHNICAL ARTICLES DEALING WITH AIRCRAFT AND ASSOCIATED SUBJECTS

For the summaries and translations from aircraft and technical journals of the world, we are indebted to the Directorate of Scientific Research and Technical Development, Ministry of Aircraft Production.

Radiolocation

ATTENTION has been drawn some time ago to British and American measures and instruments to discover the approach and strength of enemy aircraft during night attacks by means of so-called radiolocation. A few days ago the Berlin Correspondent of a Swiss newspaper reported that German night fighter aircraft had been equipped with radiolocation apparatus to locate approaching bomber aircraft. The equipment is designed to receive and determine the direction of the electro-magnetic waves emitted by the ignition system and other electric equipment of the enemy aircraft and indicates the direction and distance of the enemy aircraft by the varying strength of a light bulb. The source, whose details have not so far been confirmed, announces, furthermore, that on principle, the German Air Force is now employing only multi-seater night fighter aircraft.

German Radiolocation Equipment (*Inter Avia*, Germany).

Hydraulics or Electrics ?

ACCORDING to the authors, any system for operating landing gear, flaps and brake must meet the following requirements:—

(1) Light weight.
(2) Reliable and not vulnerable.
(3) Compact and small power loss in transmission.
(4) Semi-skilled installation and maintenance.
(5) Low cost.
(6) Capable of storing energy for emergency use.

Compressed air or vacuum operation has not been found to be reliable. This leaves the choice between hydraulic and electrical systems. It appears that there is a definite field of application for each type, the hydraulic being best adapted to variable speed control and the application of large forces.

A drawback of the hydraulic system is its greater vulnerability in aerial combat (bullets puncturing oil lines have caused fires), whilst operating at very low temperatures (i.e., below −60 deg. F.) is also likely to be difficult due to the absence of suitable liquids.

The Growth and Development of Aircraft Hydraulic System and Equipment. (H. J. Marx, S.A.E.J.) (*Digest*, U.S.A.)

Aircraft Warning

WARNING of the presence of other aircraft or of obstacles, such as mountains or high towers, is given to an aircraft pilot by the use of a new radio instrument known as the Stratoscope. This instrument, when located on an aircraft or a mountain top, will transmit a signal whose frequency is dependent upon its altitude above sea level. The transmitted signal, when received by another Stratoscope, will give an indication on a cathode-ray tube screen of the altitude of the transmitting instrument relative to the altitude of the receiving instrument. An indication of the approximate distance between the two instruments, or the aircraft in which they are mounted, is also given by the amplitude of the indication, which is dependent upon the signal strength at the location of the receiver. Because signal strength decreases with distance the pilot can make a fair estimate of the distance to the transmitter or the instrument can be calibrated. This assumes that the power output of these instruments in service is standardised at some fixed value.

The usefulness of an instrument such as the Stratoscope can be summed up in the following paragraphs.

(1) The device is an anti-collision instrument. Each pilot can see on a screen, regardless of the weather, indications of the number of aircraft or fixed obstacles located within a certain distance of his own aircraft. These indications tell him the respective altitudes and distances involved.

(2) It permits differentiation between fixed and mobile obstacles.

(3) In the case of fixed obstacles, sharp directional indications can be received. This is useful for landing or for defining the course of an airway.

(4) It is an absolute altimeter in the proximity of airports or fixed obstacles and it requires no corrections due to weather conditions.

(5) It permits airport traffic control and rapid landing facilities irrespective of weather conditions.

(6) It permits a continuous traffic control along airways which can, therefore, handle additional aircraft.

(7) Vertically separated airways can be created by the use of the Stratoscope.

The Stratoscope, A New Radio Aid to Navigation (*Aviation*, U.S.A.).

Gun Power

IT should be possible to meet the contradictory requirements which the variety of the objectives to be attacked—aircraft, tanks, armoured and unarmoured ships—is making on aircraft armament. It should suffice to follow the development trend towards increasingly heavy guns and, beyond that, to provide suitable ammunition for every mission, to make provision for a rapid exchangeability of inner tubes, gun barrels and even entire guns between operational flights, and to leave the rest of the relative slowness of the development of the equipment to be destroyed. The ideal solution would be, naturally, to be ahead of the slow evolution of the objective. In that case all kinds of replacement combinations would be created; for example, the substitution of 0.79in. (20-mm.) wing cannon by batteries of four 0.3 machine-guns or a 1.46in. (37-mm.) engine-cannon. The latter would fire shells weighing 0.67 lb. (0.3 kg.) at a muzzle velocity of 3,000 ft./sec. (900 m/sec.), would destroy the wing of an enemy aircraft by a single hit—and these 37-mm. cannon could in turn be exchanged for 2.56in. (65-mm.) engine-cannon, whose 8.8-lb. (4-kg.) shells, with a muzzle velocity of 1,000 ft./sec. (300 m/sec.), would compromise the safety of the heaviest tanks and even armoured ships.

Fighter Armament and its Development Prospects. (C. Rougeron, *Inter Avia*, France.)

Cargo Air Transport

COMMERCIAL cargo transportation by air is still in its infancy in the U.S.A. Any further development will have to take into consideration very keen competition on the part of the rail and motor trucks and will have to be planned most carefully so as to ensure sound economic principles.

The first requirement is adequate airport facilities, the sites of many of these having been selected in the past without proper regard to complementary facilities such as warehouses and truck parking space. Feeder routes will undoubtedly play an important part in air cargo developments, and the advantage of both feeder and truck lines being under one management over a certain territorial sphere at least is obvious. Under normal conditions, rates will be the biggest factor in determining the volume of air cargo. At the present time these rates are from four to seven times rail express rates. With efficient aircraft and a good ground organisation this cost should be halved in the near future, and the author is of the opinion that at these rates a considerable tonnage of goods would be deflected to the air. Much will depend on a judicious balance between size, speed and operating cost of the cargo aircraft adopted. Extensive research is being undertaken on this matter by the four major airlines which handle between 80 per cent. and 90 per cent. of the air cargo in the United States. For this purpose a separate company, known as Air Cargo, Inc., has been formed, which serves to co-ordinate the experience gained so far and initiate further development.

The importance of a sound air cargo organisation from the point of view of possible military application need not be stressed.

Operating Requirements for Air Cargo Transportation. (C. P. Graddick, 10th Annual Meeting of the Institute of Aeronautical Sciences.) (U.S.A.)

THE R.A.F. REGIMENT

Its Constitution, Organisation and Functions

AN Air Ministry Standing Order has laid down the constitution, organisation and functions of the Royal Air Force Regiment, which came into being on February 1st, 1942. The following are the more important extracts:—

The Air Ministry will undertake, as the agent of the War Office, the responsibility for executing all local defence arrangements at airdromes administered by the Air Ministry and the Ministry of Aircraft Production in the United Kingdom. All executive action to this end will be implemented through the R.A.F. chain of command in accordance with a policy laid down by the Commander-in-Chief, Home Forces. The Royal Air Force Regiment will be the chief instrument for fulfilling these responsibilities, although all R.A.F. personnel will be trained to play their part in the defence of their stations.

D.-G.G.D. and Commandant

A Director-General of Ground Defence has been appointed who will be responsible for implementing Air Ministry policy, regarding the defence of airdromes and all R.A.F. stations and establishments. He will also be Commandant of the Royal Air Force Regiment.

The Commander-in-Chief, Home Forces, will inform the Air Ministry of the tactical methods of defence to be adopted, and will have the right to satisfy himself, through his subordinates, that appropriate measures to implement his policy for the defence of airdromes are being taken.

Officers will be drawn from the following sources:—

(i) Suitable officers at present employed on full-time ground defence duties. These officers will be transferred to the Royal Air Force Regiment in their existing substantive, temporary or war substantive ranks and seniority.

(ii) Direct entrants who will be commissioned in the R.A.F. Volunteer Reserve (Royal Air Force Regiment) for the duration of the present emergency.

(iii) Army officers who may elect to relinquish their Army commissions and be appointed to emergency commissions in the R.A.F. Volunteer Reserve (Royal Air Force Regiment).

(iv) Airmen who are commissioned on passing out of the officer cadet training Unit. Commissions will be for the duration of the present emergency, regular airmen being commissioned in the Royal Air Force (Royal Air Force Regiment) and others in the R.A.F. Volunteer Reserve (Royal Air Force Regiment).

(v) A number of Army officers who will be loaned by the Army to the Royal Air Force for staff and other duties with the Royal Air Force Regiment.

Gunner vacancies will be filled by:—

(*a*) Airmen already mustered as gunners, group V.

(*b*) Aircrafthands, including those now employed on ground defence duties, who are suitable for remustering and willing to be remustered.

(*c*) Airmen who are redundant in their trades and other airmen who are willing to serve with the Royal Air Force Regiment and are recommended for training as gunners.

(*d*) Recruits from civil life. Suitable candidates will be entered as gunners, group V, in the classification of aircraftman 2nd Class.

Existing R.A.F. rank titles will be adopted. Loaned Army personnel will retain their Army rank titles.

The standard dress for all R.A.F. officers and airmen of the regiment is that of the Royal Air Force, i.e., blue-grey. Loaned Army personnel are to wear their army uniform.

When actually on duty the working dress will be R.A.F. heavy duty dress (i.e., of the same pattern as the Army battle dress with R.A.F. rank markings and badges). Army pattern equipment is to be worn. This heavy duty dress is to be worn by officers and airmen, including loaned Army personnel, but the latter are to wear Army badges of rank.

Arm Badges

All ranks, including loaned Army personnel, are to wear distinguishing arm title badges, consisting of "R.A.F. Regiment" in light blue on a dark blue background, on heavy duty dress, service dress and great coat. Airmen, except warrant officers, are, in addition, to wear the badge, arm, eagle, of the Royal Air Force.

The rate of outfit allowance payable to officers appointed to commissions after March 19th, 1942, in the R.A.F. Volunteer Reserve (Royal Air Force Regiment) will be £35. If they are subsequently transferred to ordinary R.A.F. duty, they will be required to provide themselves with a second suit of blue-grey service dress and will then become entitled to the difference between this rate and the standard rate of £45.

Death of Chris. Staniland

THE aircraft industry was shocked to learn of the death, in an air accident last week, of Flt. Lt. Christopher Staniland, Fairey's chief test pilot. No details of the circumstances have been disclosed.

Christopher Stainbank Staniland was born in Finchley on October 7th, 1905. He was educated at Tonbridge and entered the Royal Air Force in 1924. In 1928 he was serving with No. 41 fighter squadron, and later that year was transferred to the High-speed Flight of the R.A.F., which competed in the Schneider Trophy contests. He was also a well-known racing car driver, and his sense of speed and distance, plus a pair of sensitive hands, made him outstanding in both piloting and driving.

Staniland transferred to the R.A.F. Reserve in 1929, and joined Simmonds Aircraft, Ltd. (then controlled by Mr. Oliver E. Simmonds, now an M.P.). From there he went to the Fairey Aviation Co., where he remained until his death. To the company and to Staniland's relatives *Flight* offers sincere sympathy.

New Short Director

HIS many friends in the aircraft industry will be glad to learn that Mr. C. P. T. Lipscomb has been appointed to the board of directors of Short Brothers. Mr. Lipscomb, as older readers of *Flight* will know, is one of the "old-timers" at Shorts. During the period when Mr. Arthur Gouge was chief designer Mr. Lipscomb was his second-in-command, and when Mr. Gouge became general manager Mr. Lipscomb took over the post of chief designer, a position which he still occupies. His appointment to be a director of the firm is in keeping with Mr. Oswald Short's policy of finding all his key men within his own works. The success of the firm bears witness not only to the soundness of that policy, but also to Mr. Short's ability to select his team.

Controller-General, M.A.P.

MR. ALEX. DUNBAR, previously director-in-charge, Vickers-Armstrongs, Ltd., aviation section, has been appointed Controller-General at the Ministry of Aircraft Production. The post at Vickers-Armstrongs has been held by Maj. H. R. Kilner, M.C., since June, 1941.

Canadian Post-war Plans

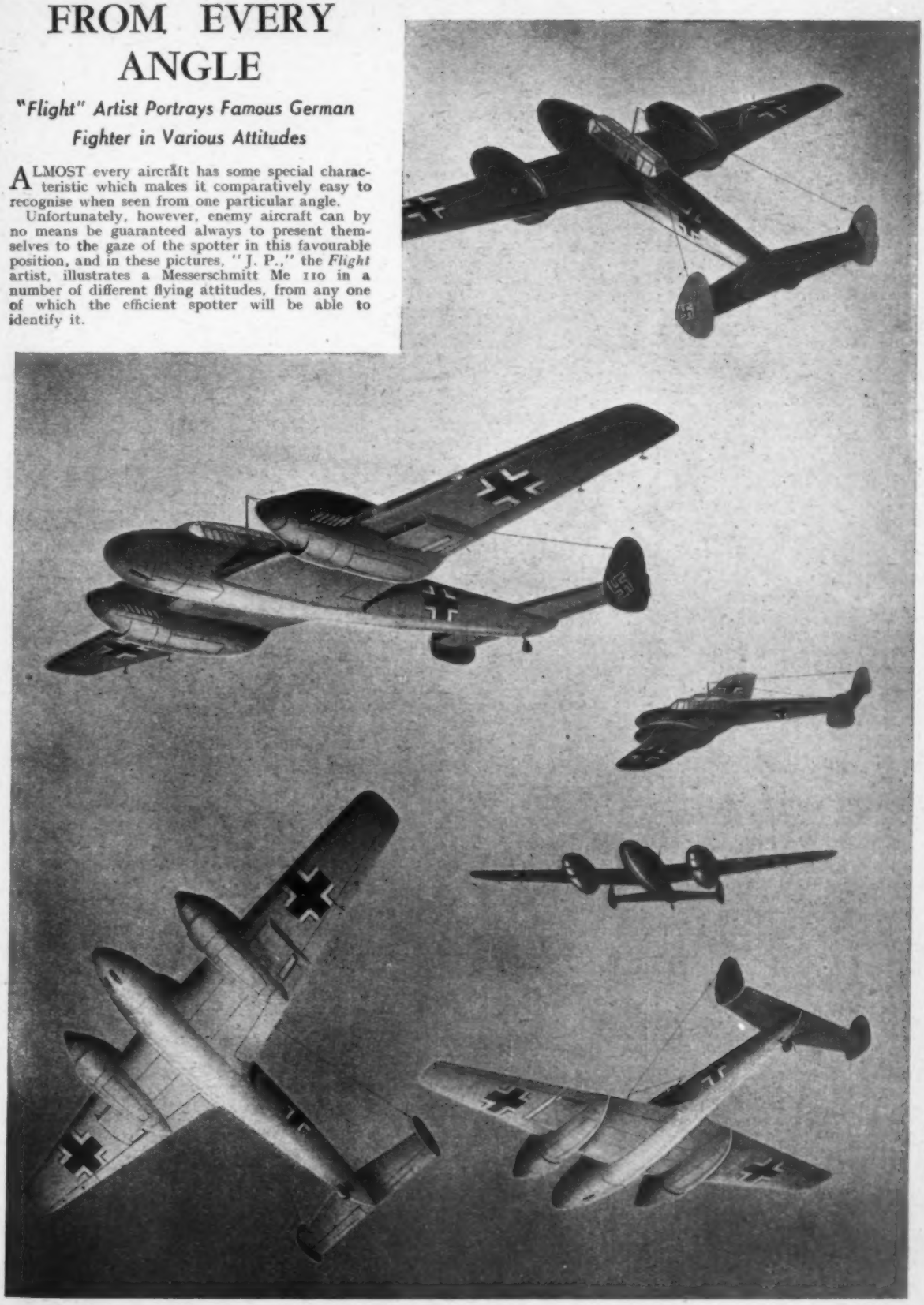
MR. H. J. SYMINGTON, president of Trans Canada Air Lines, stated to a Parliamentary Committee some time ago that as soon as the war is over there will be a direct air route between Toronto and Winnipeg, using four-engined aircraft. At present, with no machines of this class available, a detour is made north of Lakes Superior and Huron. It is thought that the more direct route will save about two hours' flying time. In spite of the Trans-Canada Act, there have been references to possible future opposition to the main-line arrangement, but Mr. Howe expressed the view that the Canadian Parliament was not likely to revise the Act, and that while the Act stands there can be no competition. Presumably the opposition expected was from the C.P.R.

FROM EVERY ANGLE

"Flight" Artist Portrays Famous German Fighter in Various Attitudes

ALMOST every aircraft has some special characteristic which makes it comparatively easy to recognise when seen from one particular angle.

Unfortunately, however, enemy aircraft can by no means be guaranteed always to present themselves to the gaze of the spotter in this favourable position, and in these pictures, "J. P.," the *Flight* artist, illustrates a Messerschmitt Me 110 in a number of different flying attitudes, from any one of which the efficient spotter will be able to identify it.



KEEPING THEM FLYING

How British Overseas Airways Maintain and Repair Their Aircraft and Equipment

ONE of the many problems confronting those responsible for the maintenance and repair of aircraft, aircraft engines, airscrews, and ancillary equipment, is that of providing the highly specialised plant, tools and test rigs necessary for the efficient handling, processing, and testing of the many varied and sometimes complicated components which form part of the modern aircraft.

At the very outset, British Overseas Airways Corporation, which has to operate throughout the world a large and fast air fleet, operating at a high standard of efficiency, encountered problems of considerable difficulty in respect of first-class, easy-to-handle, servicing equipment.

It can truthfully be said that the evolution of the aircraft has outpaced the development of the tools and servicing equipment which contribute in no small measure to its speedy and efficient turn-round or overhaul, and which, besides enabling the aircraft to spend a greater proportion of its life in its natural element, also add to economical operation by reducing maintenance costs.

The market offering of proprietary articles of plant, tools and equipment for such purposes is extremely restricted, and aircraft and aircraft engine manufacturers do not, as a rule, give much consideration to the detailed manipulation of their products after they have left the factory mainly because the problems of production are, to a large extent, divorced from those of maintenance, and more often than not it is only the operator's experience of a component under varied conditions of environment and climate which enables him to evolve special equipment needed for efficient servicing.

The Service Equipment Section

The Corporation, therefore, decided to form, as an adjunct to the Service Engineering Department, a Service Equipment Section, which would be entirely devoted to the design and development of special equipment for maintenance and overhaul. This Section, under the control of Mr. F. S. Saunders, commenced by turning out equipment which, due to lack of demand, could not be purchased outside. Later, the scope of its activities increased until to-day it has become a self-contained factory, comprising drawing and printing offices, stores, machine, fitting, erection, and construction shops. Here, apart from a large variety of finished articles, are produced rigs for testing, tools, jigs and fixtures, and other specialised equipment, some of which have been adopted by contractors controlled by the Ministry of Aircraft Production.

A number of designs, which range from a device for descaling exhaust valves, to a comprehensive test rig for automatic pilots, have been patented.

Of the wide range of products of the Service Engineering Section, the following are some of the more interesting types of rigs, from the many which have been evolved:—

The Universal Instrument Stand was produced to test instruments and units not included with the engines, such as Sperry Autopilot instruments, oil pumps, vacuum pumps, oil gauges, temperature gauges, flow meters and all the hundred and one devices employed to make the aircraft function properly. This is done by using a variable speed hydraulic unit powered by an electric motor, which drives a universal head housing the various types of pumps to be tested. Further, the rig is capable of checking gauges of all descriptions under the dead pressure testing method; automatic pilot instruments for functioning, temperature gauges, thermal couples, flow meters and many other units.

Then, the Universal Airscrew Stand was designed to receive the airscrew straight from the engine and to transport it in a vertical position direct to the airscrew repair shop on its own wheels. By means of a handle and rotating mechanism the airscrew can be turned from the vertical to the horizontal position for stripping purposes. Assembly and blade angle checking, torque loading, etc., can also be carried out, and the airscrew can be stored on the stand in the minimum amount of floor space.

An Airscrew Blade Twisting Machine for Preformed Shapes has been constructed to reset the destroyed helix angle in airscrews which have become damaged. It is a hydraulically controlled unit with two double-acting cylinders, each anchored to a moving head, and by the operation of a single handle and control valve the blade can be brought back once more to its correct helix angle. In conjunction with this machine is a thirty-ton hydraulic press of the open mouth type, which—it may be of interest to note—was not only designed but also actually constructed in the equipment shop, owing to delay in outside deliveries of parts.

Straightening Airscrew Blades

During the straightening of the blade through its longitudinal length the pitch angle is liable to be destroyed. To prevent this occurring an automatic press tool was designed to be attached to the press ram. This tool, which is operated automatically by direct contact with the object to be pressed, maintains the pitch angle under any conditions, whether the sections be thick or thin, curved or flat.

To ensure the correct functioning of the airscrew before service, a test bed was devised. The Hydromatic or Constant Speed Airscrew and Constant Speed Unit Test Stand is capable of constant-speeding the airscrew for pitch change whilst it is standing still, feathering and unfeathering, checking up on the dome assembly for proper working of valves, and pressure-testing the complete unit. It also tests the constant-speed unit for governing, accurate manual action and internal pressure, as well as for flow or volume of oil. Since the bed is fitted with complicated and numerous controls, flow meters, gauges and tachometers, which have to be adjusted in addition to the necessary function tests, full instructions are inscribed on a cylinder with an internal drum. This cylinder is provided with small oblong windows, showing only the remarks applicable to the particular test in progress. The test required is located by rotating the disc attached to the central drum against a pointer, indicating the test to be carried out, a spring-loaded ball catch locking the central drum in position. Thus, the operator is told what gauges to read, how to adjust them on each cock for pressure, whether the cock should be closed or open, the speed the tachometer should register, what flow to expect, and what should be expected of the test being performed. The speed and the power of the rig is supplied by a variable speed 6 h.p. A.C. motor, driving a gear box to which is anchored, at one end, the oil pumps, tachometer drive, etc., and at the other the constant speed control unit.

Evolutions Simulated

Another test bed, the Autopilot, Horizon and Gyro Rudder Test Rig is so constructed as to ensure that the instruments behave in precisely the same manner as they would, were the aircraft banking, climbing, diving or yawing. The tests must be extremely stringent, seeing that the instruments are called upon to perform most accurately in flight. These are also tested for recovery by the bed, which is designed to function at angles from three to fifteen degrees, and to reverse the motion each minute. The apparatus is operated by a single control.

As a last example, a Plug Testing Machine and Servicing Equipment has been evolved. With this equipment aircraft engine sparking plugs can be rapidly tested for efficient

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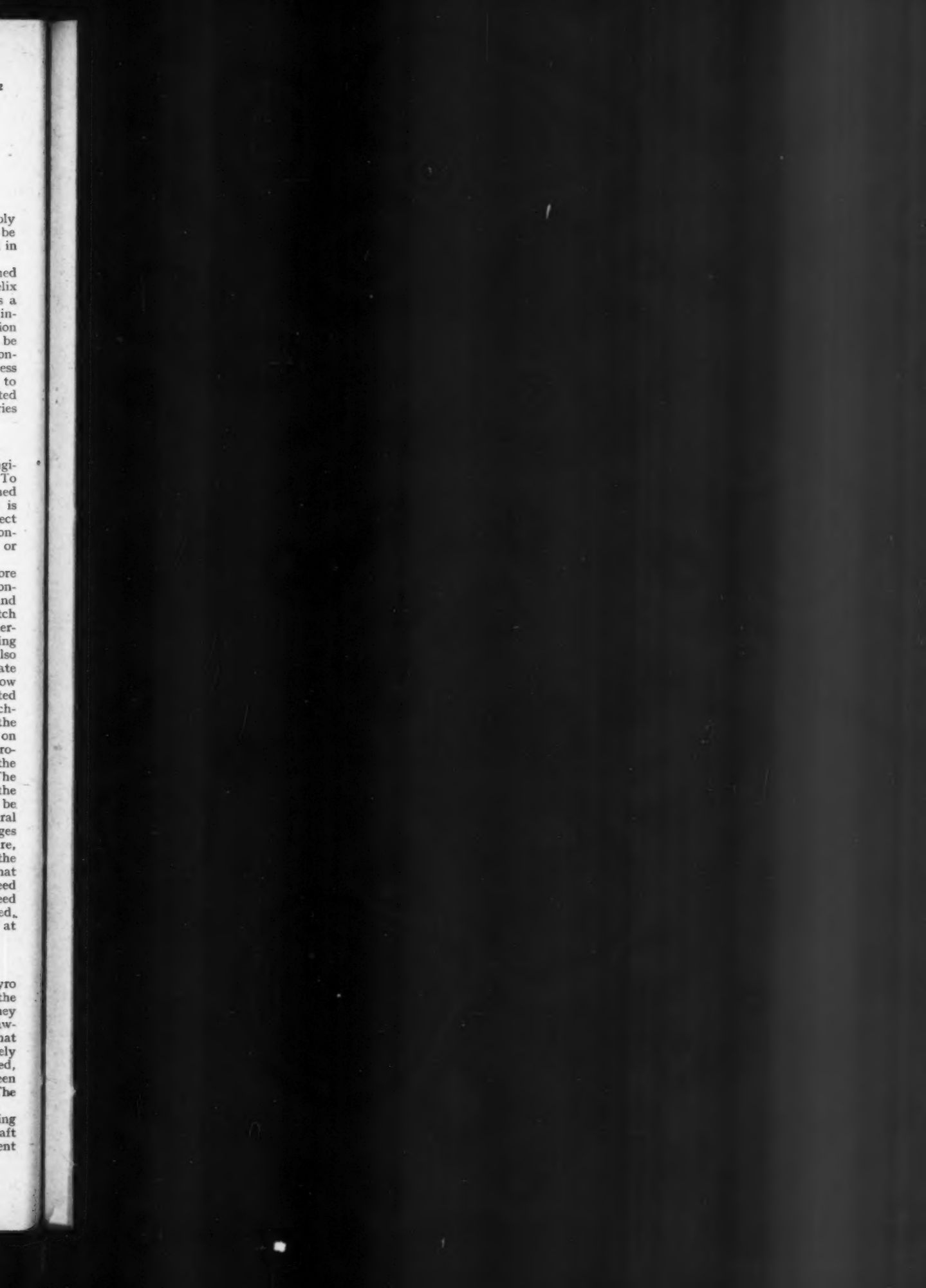


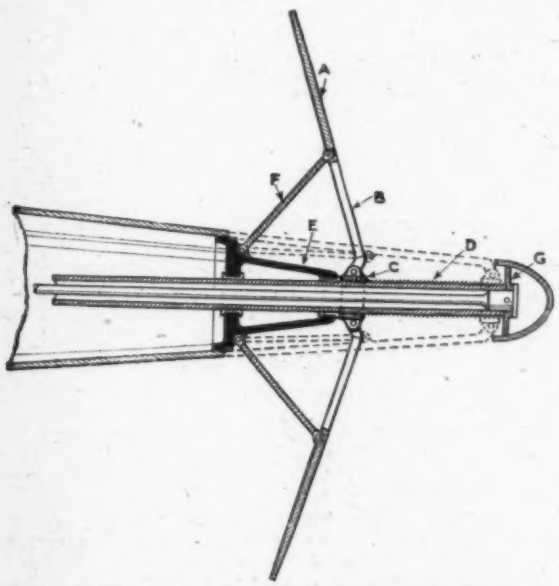
THE DORNIER DROGUE

First Details of a Much Discussed German Dive Brake

CONSIDERABLE interest has been aroused by reports of the new diving brake employed on the Dornier 217E bomber. A picture of this machine with the brake fitted, it will be remembered, appeared in *Flight* of May 21st, 1942. This represents a definite departure from the ordinary type of aerodynamic brake mounted on each wing. By braking from the extreme aft end of the fuselage, the retardation force is applied from one source only and along the longitudinal axis of the machine, in a manner calculated to give a smoothly controlled dive.

When diving through defensive fire, it is possible for the ordinary wing brakes to receive considerable damage. If one brake is badly perforated or shot away whilst the other remains substantially unaffected, course and control may well be lost, possibly with catastrophic results. The tail end location of the brake is certainly less vulnerable during diving operations.

Of course, the Dornier brake is susceptible to damage by anti-aircraft fire or by attacking aircraft. It would seem the designers had this in mind when they incorporated a jettisoning gear under the pilot's control. This is undoubtedly a useful arrangement, as to be forced to take "evading action" with the diving brake blocked in the operative position, would be just too bad. Incidentally, as the brake structure projects considerably beyond the elevators, it would seem to offer some protection against the pernicious practice, developed by Russian fighter pilots who have run out of ammunition, of closely engaging the tail of the enemy machine and chewing off the elevator with the propeller. One would imagine that while this manœuvre was in progress, to jettison the entire brake unit would be somewhat disconcerting to the attacker.



Tail-end diving brake on the Dornier 217E bomber. Operated electrically by a screw and nut gear, the brake is shown in the operative position and fully retracted in dotted outline.

It is a matter for regret that on the machine brought down in this country, and since subjected to examination, as reported in *Flight* of June 25th, only the alternative streamline tail was fitted. Thus it was not possible to ascertain the mechanical features of the brake, although the electrical gear and control were all available for inspection.

How it Works

Many enquiries have been received regarding the method of operation, and the sectional sketch herewith will end a considerable amount of speculation on the subject. The brake consists of a series of radially arranged flap members, each comprising a braking surface A, and a pair of rods B. At the rearmost end these are connected to a nut-like member C, threaded on a screwed tubular shaft D, mounted in bearings in the support framing E. Approximately midway along their length, the flaps are connected to bracing links F, pivotally anchored to the support frame. It should be noted that the bracing links are furnished with a suitably profiled surface in order to serve as brakes and supplement the action of the flaps. Rotation of tube D by an electric motor produces either forward or rearward longitudinal movement of nut C to respectively project or retract flaps A. Thus the two surfaces F and A are in virtual opposition, giving, to some extent, a total balanced surface which facilitates retraction.

It is known that modifications have been made since the initial inception of the design. Whether these have been incorporated in production units cannot, however, be stated with certainty. One such modification involved tying the member G, carrying the terminal bearing for the screwed tubular shaft at the extreme rear, to the support framing E by a series of tubes, presumably to obtain rigidity. These tubes were engaged by the lugs on the nut C, which was thus held against rotation on the shaft and definitely guided for parallel movement. A description and an illustration of the robust, four-bolt jettison gear was given in the report last week. The provision of alternative tail units which can be readily interchanged is typical of the German policy of specialised weapons for specific operations. To effect the changeover, a cockpit lever is moved, the streamline tail is lifted off, the brake unit slidingly coupled with a splined actuation rod, placed in position and the level reset.

The whole scheme, together with the method of operation, would appear to have been well thought out and deserving of close study. It would seem that the Germans "have something here."

KEEPING THEM FLYING—Continued

performance. Briefly, it consists of a clock gauge to measure the electrodes for grinding, a press for setting the points, a surface grinder and a plug testing machine, which is capable, under the control of a single lever operation, of testing a sparking plug for pressure at the glands, at the points and for checking the spark. All the operator has to do is to place the plug in the machine, lower the lever, observe the test, raise the lever and remove the plug. The time taken to test a plug is approximately three seconds.

These are a few of the test rigs turned out by the Service Equipment Engineering Section of British Airways, and they show conclusively how important such a unit is to the Corporation. Very many others have been devised, and not a few have had to be shelved until the end of the war.

MORALE IN AIR RAIDS

The "Pseudo-scientific Formula" of Lin Yutang : Fear is Generally a Diminishing Factor

By DR. V. L. GRUBERG

IN the last issue of *Flight* we discussed the most important factors determining the reaction of people subjected to air attacks, viz., intensity and frequency of raids, fear, hatred of the enemy, material attachment, A.R.P. and A.A. defence, intensity and kind of influence of domestic propaganda.

In a graph it was attempted to illustrate the relationship of the factors to which a Spanish authority attaches the highest significance. These are fear, hatred, and the moral energy to act collectively, to translate emotions into actions. According to General Herrera, the reaction in favour of peace can be formulated as follows:—

$$R = E(F - H),$$

where R = Reaction, E = Energy, F = Fear, H = Hatred towards the enemy.

But while it is admitted that the above are unavoidable components of such reaction, the significance of those other factors, enumerated before, should not be ignored.

National Characteristics

No doubt in studying the reactions of human communities to air raids one has to take into account their inherent national characters, social conditions, etc., etc. Indeed, to put emotions into formulas is to court dangers of misrepresentation and is, perhaps, as the famous Chinese philosopher Lin Yutang put it, "in itself a lack of the sense of humour, and, therefore, a lack of wisdom."

Lin Yutang says that "human beings and communities believe differently according to their different compositions, as sulphates and sulphides or carbon monoxide and carbon dioxide behave differently from one another." His witty analysis of the national characteristics for which he developed a "pseudo-scientific formula based on his knowledge and on the gaps of his ignorance" is formulated in the following amusing manner:—

"Let 'R' stand for a sense of reality, 'D' for dreams (or idealism), 'H' for a sense of humour, and—adding one important ingredient—'S' for sensitivity. And further, let '4' stand for 'abnormally high,' '3' for 'high,' '2' for 'fair,' and '1' for 'low,' and we have the following pseudo-chemical formulas for the following national characters:—

R_2	D_2	H_2	S_1	=	English
R_2	D_3	H_3	S_1	=	French
R_3	D_3	H_2	S_2	=	American
R_3	D_4	H_1	S_2	=	Germans
R_2	D_1	H_1	S_1	=	Russians
R_2	D_2	H_1	S_1	=	Japanese
R_4	D_1	H_2	S_3	=	Chinese

(The Japanese and Germans are very much alike in their comparative lack of humour, yet it is really impossible to give a "zero" for any one characteristic in any nation. . . .)"

The "Fear" Factor

This convenient and picturesque representation of the national characters should help us to realise the multitude of nuances which colour the reactions of different national groups. Only in this light can we attempt to examine the influence of factors which go to make the morale of people under air-raid conditions.

In the last issue we suggested, supported by results of our enquiry into the reaction of 100 people with extensive "blitz" experience, that the factor "Fear" (F) is decreasing with the continuation of raids. To a considerable extent is fear influenced by the existence of A.R.P. and A.A. defences (Ar). Thus. 55 per cent. of our enquiries brought the reply that the noise of A.A. guns was "soothing," "pleasing," or "calming"; there was a slight variation in the case of women, who, while confirming the above effect, qualified it by stating that it was so "after a short time, when they were able to differentiate between the thud of falling bombs and the A.A. fire." One may assume that "F" is inversely proportional to "Ar."

Even before the actual beginning of air raids, the factor Ar is strongly counteracting the apprehensions and fears which are then very high. A good instance is the balloon barrage. *Mass Observation* states that the reassurance value of the balloon barrage for certain sections of London's population came out in answers to the question, "Do you think there are likely to be air raids in London? Do you think they will be severe or slight?" which was asked over the period of October 13th to November 2nd, 1939, by members of the British Psychological Society. Of the 338 people interviewed, nearly half said there would be *no* raids on London: an opinion which was largely fostered by the appearance of the balloon barrage.

Let us now take the influence of other factors. There is no doubt that in the case of Germany the influence of propaganda is much higher than in this country. For years now the Nazis propaganda machine has relentlessly subjected the Germans to cunning propaganda which, if often crude, is just right for German home consumption. Yet the effect of this propaganda does not necessarily mean that it fortifies the resistance of the public to air attacks. In fact, in the case of Germany it is just the contrary. Imagine crowds of Germans intoxicated with the propaganda of the invincibility of their forces, of their *Luftwaffe*, of their "air space," subjected to a raid *à la* Cologne. In fact, two days before the R.A.F. raid on Rostock the Germans were told by a Major Wulf Bley, an official spokesman of the Nazi Air Ministry, that their air defences were impregnable. "To-day," said the Major, "German air supremacy has made it impossible for the enemy to endanger German production and supply lines." The subsequent smashing R.A.F. raids must have been to many Germans—no matter how little they may indulge in individual thinking—a sore awakening and a serious psychological *shock*.

Household Goods

And then another factor: what we call here "Material attachment" is the sentiment of the people to their material possessions. While this is a sentiment inherent with all people of any race or colour, the German appears to have it in higher grade of intensity. The German "man-in-the-street" does not see in his table, chair or wardrobe, just a valuable article of his household. His is an acute realisation of the many working hours he spent on the purchase of the object, and for this reason the table, etc., represent to him something which he prizes highly, and respects profoundly—the fruits of his labour. It is no exaggeration to suggest that the destruction of material values and personal property hits the average German far deeper than it does the inhabitant of this island.

No matter how much Nazi propaganda may attempt to persuade him that he fights in *his defence*, he has been intoxicated with the drug of conquest and success of arms. He takes delight in the conquest of Poland, France, Belgium, Holland, Norway, Crete, etc. He has been warned to believe that he is the irresistible conqueror. Suddenly he faces the dangers *at home*, deep inside his own invincible country, and witnesses the destruction of *his own* material values. There is no doubt that the psychological shock is terrific. Of a quite different order than it is to the man-in-the-street in this country, who took arms in the profound feeling of self-defence and knowledge of un-

preparedness for war. Paradoxically enough, this realisation of the British unpreparedness for war was a psychological factor in fortifying the resistance of the people of this island. For whereas the German experiences the blow of air attack while he imagines himself to be at the very zenith of his power, the people here had the justifiable feeling of better defence with the progress of their re-arming.

The reaction of a multitude will, therefore, largely depend on these factors and their correlation. In some cases air raids may produce a "reaction for peace"; that is, a general desire to stop them by giving in one way or another. In such instances the object of the raids would have been achieved. Clearly, even this reaction in favour of peace will also depend on the existence of a moral energy (E), which is the collective energy capable of translating group emotions into action. Experience shows that under air-raid conditions E is not too high, and rather tends to reduce with the continuation of raids.

Formula of Reaction

In other cases, the same factors will produce just the opposite effect; that is, the desire to hit back and to fight it out. Whether one or the other reaction sets in will depend on the intensity and correlation of the enumerated factors.

To estimate, however, the morale of people under air raid and the extent to which air raids on civilian centres can serve a war purpose, we are primarily interested in the "reaction for peace" (R).

We may say that R is a logarithmical function of In (Intensity).

If we accept the factors enumerated above, it is possible to formulate the total reaction for a desire for peace as brought forth by the pressure of air attacks in various forms.

Two possible forms are given below:—

(1) $R=E\ (M+F-H-Ip)\quad (log\ In+log\ fr)$

This is roughly true, but in approaching infinity the relationship breaks down.

(2) $R=\dfrac{E+M+F+log\ In+log\ fr}{H+Ip}$

Where M is the material attachment, Ip = intensity of propaganda, fr = frequency of raids.

The first embodies Herrera's original formula and has the advantage that it can be expressed in a two-dimensional graph.

According to this formula, R can attain a high negative value indicating reaction in favour of prolonging the war, or of fighting it out, whereas formula (2) in the limit can only become infinitely small.

General Application

But while the complexity of the interplay of the psychological factors has been reduced to simplicity, it can be nevertheless generally applied to express the correlation of the relevant factors. Evidence has been brought forward to show that the intensity of these factors will differ in various countries. Thus one may say that it is stronger in Germany than in this country, H as well as F are more or less equal, etc.

From the above we may deduce that the "morale" is by far more complicated than it is commonly acknowledged to be. It appears, further, that certain factors such as fear, if important, are rather of a secondary nature, while far more important are other psychological factors, such as described above. It is indeed these other factors which go to make all the difference between the reactions which may, as in the case of Germany, produce the expected results. Indeed, in a country like Nazi Germany, the character and grade of psychological factors are the vulnerable chinks in their armour. Intense and incessant air attacks on the Nazi hinterland stand, therefore, a good chance to produce the wanted effect—the collapse of Germany's spirit of aggressive war.

HAWKER SIDDELEY AIRCRAFT

Mr. Sopwith's Speech at Annual General Meeting

AT the annual general meeting, held on July 1st, Mr. T. O. M. Sopwith, chairman of the board of directors, pointed out that interim dividends of 15 per cent., less tax, and 17½ per cent., less tax, had already been paid, and that no further dividends would be paid for the year. Other points from Mr. Sopwith's speech follow:

Of the products of your company—which have been, and still are, rendering yeoman service in every part of the world where hostilities are in progress—I can, unfortunately, speak only with reticence. You can, however, be assured that their contribution is one of vital importance and of great value to the Armed Forces. I need only, I think, call attention to three. There is the ubiquitous "Hurricane," with various modifications and improvements, but substantially the same, still used for varied jobs and with efficiency and certainty. The epic stories associated with the achievements of this remarkable machine will, I hope, be available to constitute a permanent record of gallant men and daring exploits. The "Lancaster"—the latest product, and I think the most efficient heavy bomber in the world—was the medium through which the historic raid on Augsburg was carried out; this aircraft, in increasing numbers, will add very materially to our bomber offensive. Lastly, certain of the "Whitley" bombers have been converted to commercial types to augment the fleet of British Overseas Airways. In the post-war development of civil aviation your company is adequately equipped, both from the technical and production aspect, to take full advantage of any opportunity which may occur.

During the period of the war I cannot indicate future developments other than by giving you an assurance that we are determined to maintain a progressive policy. There is little doubt that the quality of the R.A.F. equipment in darker days proved a deciding factor, and had it been possible then to have quantity as well the outlook might have been vastly different. To-day, however, the manufacturing potential is available and able to provide the numbers of new types necessary to maintain the hard-earned superiority.

High Standard of Efficiency

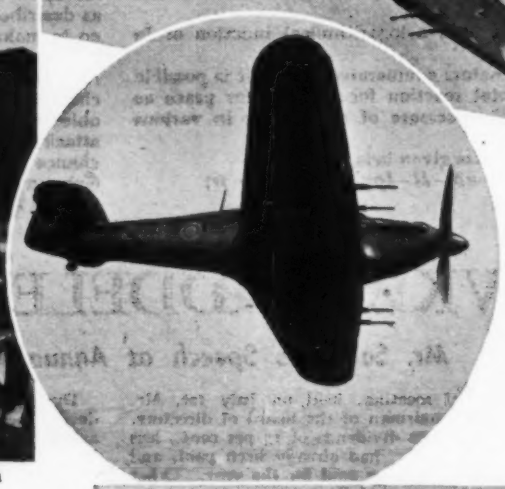
In the other ancillary products covered by your company the same satisfactory state of affairs prevails, and the high standard of mechanical efficiency in certain equipment can be ascribed in part to developments carried through on our initiative. It is a pleasure to record that our relations with the works personnel are on a basis of friendly co-operation; there has been of late a noticeable tendency in private and public discussions to criticise managements and workers, and exaggeration has been shown in many statements. An industrial expansion of the magnitude which has occurred in this country cannot take place without some inefficiency, but, on the whole, the attainment of full production has been remarkably free from confusion or conflict.

The percentage of female labour, both clerical and productive, employed in this organisation has increased appreciably. Their work is extremely valuable, and I would emphasise the importance of their contribution.

CHINA-BRITISH

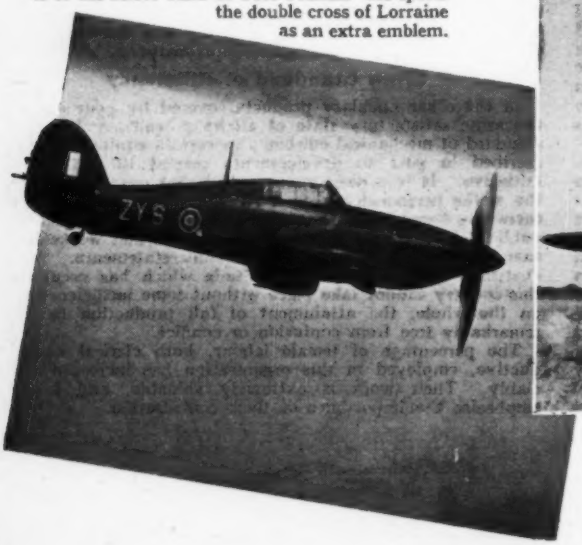
The Men and Machines of a Hurricane IIC Squadron Subscribed for by British Communities in China

A group of pilots of the China-British squadron. The badge of the squadron incorporates the Chinese characters "Chu Feng" or Hurricane, and the motto is "Rise from the East."



(Above) Two of the Hurricane IICs in formation over the sea. The standard of flying is very high. (Circle) In this view from below the 20 mm. cannons appear to be very small. When it first came into use the Hurricane IIC was the hardest - hitting fighter in the world.

One of the pilots of the China-British squadron is of the select band of Free French. He sports the double cross of Lorraine as an extra emblem.

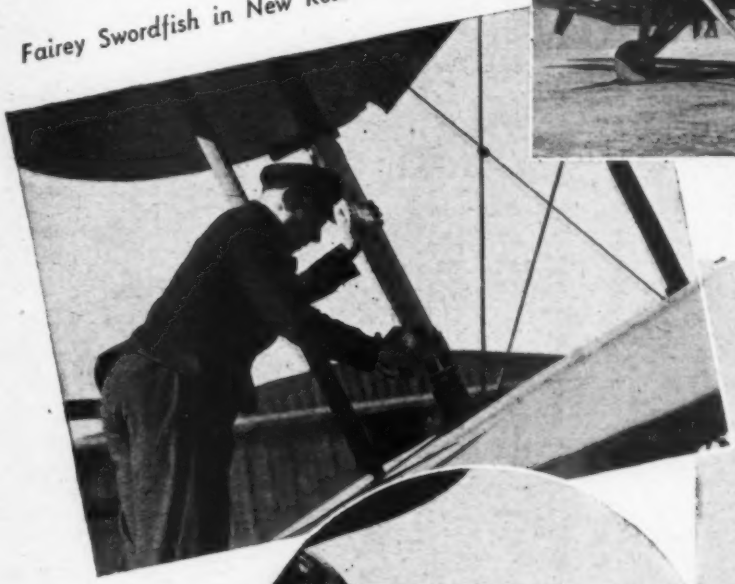


(Left) A side view in flight which shows off the Merlin-engined Hurricane IIC to advantage. Earlier Hurricanes had both fuselage and wings fabric covered, but now fabric is retained on the body only. (Above) Squadron ground staff servicing aircraft at their dispersal points.

FLEET AIR ARM "MET." FLIGHT

Fairey Swordfish in New Role

(Above) The wings of the Swordfish are unfolded before the machine is prepared for flight.



One of the ground staff filling the container of the wet-bulb strut thermometer.

(Circle) A Fleet Air Arm rating fits a new oxygen bottle in the pilot's cockpit. Meteorological flights usually extend to over 30,000ft.

(Above) The observer in the rear cockpit carries a barometer, marked in millibars, in a container on his chest.

(Above) In the rear cockpit the observer prepares his pad for taking observations. (Right) The pilot settles himself in the front seat, straps on his oxygen/microphone mask before taking off on a very cold flight.

Correspondence

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

AD ASTRA

Wright Bros.' First Machine

WITH reference to the article "Ad Astra" by the Rt. Hon. Lord Brabazon, in your issue of June 4th, might I point out that the Wright Brothers' first machine was destroyed in a crash, and that the machine in the Science Museum, though built by them, is merely a replica, and has never been flown?

REG. JUDSON.

JET PROPULSION OF AIRCRAFT

Formula for Calculating Thrust

SOME weeks ago you printed a letter from me, in which I expressed some doubts on the feasibility of any system of jet propulsion for aircraft in which the thrust is obtained by the introduction of heat into the air stream. Since then I have given the problem further consideration, the results of which I would like to submit to your readers for criticism.

As already pointed out by one of your correspondents, the tube through which the jet of air passes would have to be of the form shown in the figure.

Using the following symbols :—

p = air pressure in lb./ft.²
ρ = air density in slugs/ft.³
T = air temperature in °C. absolute
V = air velocity in f.p.s.
A = cross sectional area of tube in ft.²
C_v = specific heat of air in ft. lb./lb. °C. = 234 ft.lb./lb.°C.
$\gamma = \frac{C_p}{C_v} = 1.4$ (ratio of specific heats)

and assuming that at inlet $p_1 = 2{,}120$ lb./ft.², $\rho_1 = 0.00238$ slugs/ft.³, $T_1 = 288$ °C., $V_1 = 300$ f.p.s. and $A_1 = 5$ ft.² we have :

Mass of air flowing per second $= \rho_1 A_1 V_1 = 3.57$ slugs. For a compressible fluid we have, instead of the ordinary Bernouilli equation, the formula

$$V_2^2 = V_1^2 + \frac{2}{(\gamma-1)}\gamma\frac{p_1}{\rho_1}\left\{1 - \left(\frac{p_2}{p_1}\right)^{\frac{\gamma-1}{\gamma}}\right\}$$ when the flow is adiabatic.

Applying this formula to the flow between sections 1 and 2 we obtain $V_2 = 200$ f.p.s., $T_2 = T_1\left(\frac{p_2}{p_1}\right)^{\frac{\gamma-1}{\gamma}} = 290.3$°C., $\rho_2 = 0.00243$ slugs/ft.³ and $A_2 = 7.35$ ft.².

It is now assumed that between sections 2 and 3, 2×10^6 ft.lb. of energy are added to the air in the form of heat every second (= 3,640 h.p.).

The effect of this heat on the pressure velocity, density and temperature of the air can be found from the following equations :

Momentum equation :—$(p_2 - p_3)A_2 = M(V_3 - V_2)$ lb.

Work done against external pressure $= M\left(\frac{p_3}{\rho_3} - \frac{p_2}{\rho_2}\right)$ ft./lb.

Gain in internal energy $= (T_3 - T_2)C_v g M$ ft./lb.

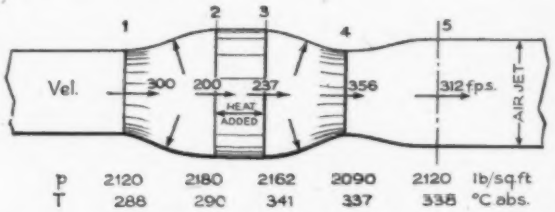
Gain in kinetic energy $= (V_3^2 - V_2^2)\frac{M}{2}$ ft./lb.

If the sum of the last three expressions be equated to the heat added and taking into account the momentum equation, we obtain :—

$V_3 = 237$ f.p.s., $p_3 = 2{,}162.0$ lb./ft.², $\rho_3 = 0.00205$ slug/ft.³, $T_3 = 340.8$ °C. abs.

Using the modified Bernouille equation for compressible adiabatic flow, we next obtain (assuming $A_4 = A_1 = 5$ft.²), $V_4 = 356.0$ f.p.s., $T_4 = 337$ °C. abs., $\rho_4 = 0.00201$ slugs/ft.³, $p_4 = 2{,}090$ lb./ft.².

The conditions in the slip stream after adiabatic expansion to $p_5 = 2{,}120$ lb./ft.² are $V_5 = 312.0$ f.p.s., $T_5 = 338$ °C. abs., $\rho_5 = 0.00205$ slugs/ft.³.



p	2120	2180	2162	2090	2120	lb/sq.ft
T	288	290	341	337	338	°C abs.

The resultant thrust can be calculated in two-ways. First, total change of momentum per second = 3.57 slugs × $(V_5 - V_1)$ = 42.8 lb.

Second. Average outward pressure between 1 and 2 is approximately $\frac{2120 + 2180}{2} = 2150$ lb./ft.².

Average outward pressure between 3 and 4 is approximately $\frac{2162 + 2090}{2} = 2126$ lb./ft.².

The resultant thrust due to these pressures is roughly $(2150 - 2126)(A_3 - A_1) = 24 \times 2.35 = 56.4$ lb. which agrees fairly well with the first value.

Efficiency of propulsion is given by $\frac{\text{Useful work}}{\text{Heat added}}$

$$= \frac{\text{Thrust} \times \text{Velocity of aircraft}}{\text{Heat added}} = \frac{42.8 \times 300}{2 \times 10^6} = 0.0064;$$

Or the efficiency of propulsion is 0.64 per cent.

In the foregoing calculation no allowance has been made for losses due to turbulence, which would surely be considerable in the divergent portion of the tube between 1 and 2.

R. M. HELSDON.

Technical College, Coventry.

BOOKS FOR WIRELESS TRAINING

WIRELESS has become so important in the war, especially to the air services, that reliable technical books are very much in demand. Technical books issued from the offices of the *Wireless World* have earned a high reputation in the past, and to-day they supply the needs of all branches of the Services.

Theoretical books written from a practical point of view include "Foundations of Wireless." This book, from an elementary beginning, brings the student up to the stage where he can read and understand circuit diagrams and provide himself with a good foundation of wireless theory. "Radio Designers' Handbook" might be described as a manual packed with practical information and describing the use of formulæ required by the radio designer; a book specially imported from Australia because nothing like it had been produced here.

Those whose business it is to maintain wireless equipment will find the "Wireless Servicing Manual" a really practical guide, where the object of the author has been to make the reader understand what he is doing in testing rather than working mechanically to a plan. Another volume, which may be regarded as a companion, is "Radio Laboratory Handbook," describing apparatus used in a testing laboratory and its operation.

Specialised branches of radio are catered for, and "Wireless Direction Finding" is a big volume which covers theory and practice of the various branches of this subject, whilst "Television Receiving Equipment" will meet the needs of those in training for work where cathode-ray tubes will be employed.

The operating side of wireless has not been forgotten, and nearly a quarter of a million copies of a sixpenny booklet, "Learning Morse," have been sold since the beginning of the war.

Service Aviation

Royal Air Force and Fleet Air Arm News and Announcements

Pilots of Czechoslovakia are highly regarded in the R.A.F. Here is a portion of a squadron, flying Spitfires in formation.

The W.A.A.F. is Three Years Old

SPECIAL church services and parades, birthday parties, sports and concerts were arranged for Sunday, June 28, to mark the third anniversary of the formation of the W.A.A.F. These took place at every R.A.F. station where there are W.A.A.F. serving, and the airwomen were hostesses to the R.A.F. At one station the W.A.A.F. cooks made a large three-tier birthday cake, crowned with three candles.

The director of the W.A.A.F. took the salute at a unit where more than 1,000 airwomen marched past.

Much has been achieved in three years by this women's service, which is an integral part of the R.A.F.

The Service is a successor to the Women's Royal Air Force which was demobilised after the last war. The Munich crisis of 1938 led to the formation of the Auxiliary Territorial Service which had special R.A.F. companies. Women wishing to volunteer for duty with the R.A.F. were entered as members of these companies. On June 28, 1939, the King approved the formation of a separate service "to be designated the Women's Auxiliary Air Force, to serve with the R.A.F. in time of war."

Originally there were five trades; today there are more than fifty for airwomen and sixteen branches for officers. At the beginning of this year the W.A.A.F. was the largest women's service, and its present strength is more than 100,000, nearly all of whom are volunteers.

Its object, that of replacing officers and men of the R.A.F. employed on ground staff duties, has been fulfilled. To-day, members of the Service are serving in all the R.A.F. Commands at home, as well as in the Middle East and the United States of America.

Officers and airwomen are taking an active and important part in the ground work involved in the bomber raids and fighter sweeps which are being carried out by the R.A.F. They are being employed as photographic interpretation officers, meteorological officers, code and cipher officers, intelligence officers, and in many other skilled and necessary occupations. They contribute valuable service in other ways—in cooking meals for air crews to take on raids and to be ready for them on their return. Indeed, this type of service is vital, that is why the demand for cooks as the W.A.A.F. enters its fourth year of life is so great.

Awarded the D.F.C., Sqn. Ldr. C. E. Malfroy, of No. 66 Squadron (Auxiliary Air Force).

Pictures for the R.A.F.

A NOVEL scheme for providing R.A.F. messes and depots with paintings and drawings has been launched under which members of the public are invited to lend their works of art to the flying service "for the duration."

Already over 300 framed paintings, and several hundreds of unframed engravings, drawings and cartoons have been lent to the Central Institute of Art and Design, which is sponsoring the R.A.F. Picture Scheme. Most of these have been given by the artists themselves, and many more have offered their works, but are short of frames, or find transportation difficult.

Awards

THE KING has been graciously pleased to approve the following awards in recognition of gallantry displayed in flying operations against the enemy:—

BAR TO THE DISTINGUISHED FLYING CROSS.

Act. Sqn. Ldr. G. K. GILROY, D.F.C., A.A.F., No. 609 Sqn.—Since this officer was awarded the D.F.C. in July, 1940, he has destroyed an additional seven enemy aircraft and damaged a further two, making a total of ten destroyed and four damaged. Under his command his squadron has met with considerable success in the destruction of enemy aircraft. He is a first-class fighter pilot and an excellent leader.

SERVICE AVIATION

DISTINGUISHED FLYING CROSS.

Act. Wing Cdr. P. H. WOODRUFF, R.A.F.O., No. 404 Sqn.—On May 17th, 1942, this officer led a formation of bomber aircraft in the attack on the German Cruiser *Prinz Eugen*. Despite interference from enemy fighters, Wing Cdr. Woodruff accomplished his task in a skilful and determined manner. Throughout he showed great leadership and determination. He has commanded the squadron since May, 1941, and, by his personal example, has contributed largely to its high standard of operational efficiency.

Sqn. Ldr. C. E. MALFROY, A.A.F., No. 66 Sqn.—This officer is a most efficient and courageous fighter pilot, whose example has contributed materially to the high morale and fighting spirit of the personnel with whom he has served. He has destroyed at least four enemy aircraft and damaged several others.

Act. Sqn. Ldr. J. S. DINSDALE, No. 42 Sqn.—On May 17th, 1942, this officer led a formation of Beaufort aircraft in an attack on the *Prinz Eugen*. Despite heavy fire from the cruiser and accompanying destroyers, a most determined attack was carried out. Sqn. Ldr. Dinsdale has completed many operational sorties, including an attack on the *Scharnhorst* and *Gneisenau* in the English Channel. His leadership and skill are of a high order.

Act. Flt. Lt. V. H. EKINS, R.A.F.V.R., No. 501 Sqn.—This officer has carried out many offensive sweeps and reconnaissances, including attacks on shipping and ground targets in enemy territory, and has damaged three enemy aircraft. He is a skilful and gallant officer, whose indomitable spirit and cheerful courage have been an inspiration to his squadron.

Act. Flt. Lt. R. A. NEWBERY, R.A.F.V.R., No. 118 Sqn.—This officer has participated in a large number of operational sorties over enemy territory. These sorties have included fighter sweeps, successful low level attacks against ground targets and ships at sea and bomber escort flights. He has at all times shown the greatest keenness and enthusiasm for operational flying.

Act. Flt. Lt. D. A. PARKINS, R.A.F.V.R., No. 15 Sqn.—One night in June, 1942, this officer was the captain of an aircraft which participated in a bombing attack on Essen. Despite unfavourable weather, industrial haze and smoke, and in the face of heavy anti-aircraft fire, Flt. Lt. Parkins made repeated runs over his target to ensure accurate bombing. His aircraft was extensively damaged, but, displaying fine airmanship, he flew it safely back to base. This officer showed great determination and devotion to duty throughout. He has completed numerous sorties and, on all occasions, he has shown courage and reliability.

Act. Flt. Lt. W. J. ROSSER, R.A.F.V.R., No. 130 Sqn.—This officer has participated in many sorties over Northern France and has destroyed two enemy aircraft and damaged four others. He shows great keenness in engaging the enemy and is an excellent leader.

Act. F/O. H. W. W. BERRIDGE, R.A.F.V.R., No. 219 Sqn.—This observer has participated in many night fighting sorties against the enemy and has taken part in the destruction of three enemy aircraft. He has shown great skill and determination.

Act. F/O. E. W. SEABOURNE, R.A.F.V.R., No. 276 Sqn.—This officer is employed on air/sea rescue work, and by his devotion to duty sets an excellent example to other operational pilots. He has undertaken rescue work in all weather conditions, and, on one occasion, went 50 miles out to sea when visibility was less than 1,000 yards. Prior to starting his present duties he destroyed three enemy aircraft and assisted in the destruction of another.

For a large number of operational sorties Act. Flt. Lt. R. A. Newberry (No. 118 Squadron) has been awarded the D.F.C.

P/O. E. F. PAIGE, R.C.A.F., No. 407 (R.C.A.F.) Sqn.—In May, 1942, this officer was the pilot of an aircraft which participated in an attack on a convoy off the enemy coast. Regardless of a fierce defensive barrage which, in the full light of the morning, was extremely accurate, P/O. Paige pressed home his attack. Although he was seriously wounded by a splinter from a shell which smashed through the instrument panel, this officer courageously flew his aircraft back to base. Some few nights earlier, P/O. Paige made a successful attack on a large enemy vessel from a height of only 75 feet.

P/O. J. E. PECK, R.A.F.V.R., No. 126 Sqn.—This officer is a courageous and resourceful leader who always presses home his attacks with the greatest determination. He has destroyed at least three hostile aircraft and damaged many more.

P/O. L. SCORER, R.A.F.V.R., No. 602 Sqn.—This officer, who has completed 71 sorties over Northern France, is a courageous and determined pilot. He has destroyed one and damaged several more hostile aircraft.

P/O. R. F. TILLEY, R.C.A.F., No. 126 Sqn.—This officer is a most determined pilot who has destroyed at least four enemy aircraft. On three occasions, by making feint attacks after having expended all his ammunition, he has successfully driven off enemy fighters which attempted to machine-gun our aircraft as they landed. He has displayed great gallantry.

P/O. P. H. WATSON, R.A.A.F., No. 457 (R.A.A.F.) Sqn.—This officer is a most capable leader who displays great coolness and courage in action. He has participated in over 40 sorties and his inspiring example has proved a great source of encouragement to other members of his flight.

DISTINGUISHED FLYING MEDAL.

Flt. Sgt. G. C. D. BELL, R.C.A.F., No. 404 Sqn.—On May 17th, 1942, this airman was the captain of a Blenheim aircraft which took part in the attack on the cruiser *Prinz Eugen*. Throughout the operation he displayed great skill. An enemy fighter which attempted to intercept was engaged and resolutely driven off. Flt. Sgt. Bell has shown a fine fighting spirit and never hesitates to volunteer for a sortie when the occasion arises.

Flt. Sgt. R. C. SHERRINGTON, R.A.F.V.R., No. 23 Sqn.—This observer has completed a large number of intruder sorties, during which he has participated in the destruction of a number of enemy aircraft. He is a keen navigator who is also accurate in his bombing and coolly efficient at all times.

Sgt. W. C. FERGUSON, No. 101 Sqn.—Sgt. Ferguson was the rear gunner of an aircraft which participated in a raid on Essen. Whilst over the target area, the aircraft was attacked by a Junkers 88 but, following a well-directed burst of fire by Sgt. Ferguson, the enemy aircraft broke off the engagement. On the return journey, shortly after crossing the Dutch coast, the aircraft was attacked by another enemy fighter. Coolly opening fire from close range, Sgt. Ferguson delivered an accurate burst of fire, causing the attacker to break away and dive towards the sea in flames. This airman has taken part in numerous sorties and has always displayed great skill and devotion to duty.

Sgt. R. S. GIBBONS, No. 86 Sqn.—On May 17th, 1942, this airman was the air gunner of a Beaufort aircraft which participated in an attack on an enemy naval unit off the Norwegian coast. Whilst flying over the target area the aircraft was intercepted by a strong force of enemy fighters. Sgt. Gibbons was wounded in the face and left hand, and, shortly afterwards, his guns were put out of action. Despite this, he remained in his turret and gave directions to his pilot, who was thus enabled to manœuvre his aircraft so as to bring the other guns to bear with good effect. This airman displayed great courage and coolness throughout.

THE KING has been graciously pleased, on the advice of Canadian Ministers, to approve the posthumous award to the undermentioned:—

GEORGE CROSS.

L.A/C. K. M. GRAVELL (deceased), R.C.A.F.—In November, 1941, a training aircraft crashed and immediately burst into flames. L.A/C. Gravell, who was under training as a wireless air gunner, managed to extricate himself from the wreckage and get clear. In spite of the intense shock caused by the loss of one eye and severe burns, suffered at the time of the crash, L.A/C. Gravell's first and only thought was for the welfare of his pilot. The pilot was still in the aircraft and Gravell, ignoring his own serious injuries and the fact that his clothes were ablaze, attempted to get back to the flaming wreckage to pull him clear. He had barely reached the aircraft when he was dragged away and rolled on the ground to

Pilots of the American Eagle Squadron "count-in" some of their comrades before mounting their own aircraft.

Act. Flt. Lt. V. H. Ekins, of No. 501 Sqn., has been awarded the D.F.C. for many offensive sweeps and reconnaissances.

extinguish the flames which had by this time completely enveloped his clothing. L.A/C. Gravell subsequently died from his burns. Had he not considered his pilot before his own safety and had he immediately proceeded to extinguish the flames on his own clothing, he would probably not have lost his life.

THE KING has been graciously pleased, on the advice of Canadian Ministers, to approve the award to the undermentioned:—

GEORGE MEDAL.

Sgt. F. B. LUMMIS, R.C.A.F.—This airman was engaged in draining petrol from an aircraft in a hangar. As a result of an electric lamp breaking into a petrol can the petrol was ignited. Sgt. Lummis seized the burning can and after two attempts succeeded in removing it from the hangar. In this act of bravery he showed total disregard for his personal safety and the greatest courage, as by the time he got outside he was a mass of flames. He thereby saved twelve aircraft which, at this date, were invaluable to Canada's air training plan.

Roll of Honour

Casualty Communiqué, No. 138.

THE Air Ministry regrets to announce the following casualties on various dates. The next of kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

Royal Air Force

KILLED IN ACTION.—Act. Flt. Lt. R. G. W. Beveridge; Flt. Sgt. G. H. Davison.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. W. A. Brooks; P/O. I. C. Burke; Sgt. W. F. Butler; Sgt. T. P. Butterfield; Sgt. A. Carstairs; P/O. A. R. Fitch; Sgt. J. Gibson; Flt. Sgt. H. A. Goldsmith; Sgt. I. Hamilton; Sgt. S. G. Harding; P/O. J. G. Heatherington; Sgt. D. E. Hodgkinson; Sgt. T. G. Lister; Sgt. D. J. Mackintosh; Flt. Sgt. A. L. Narracott; Sgt. A. J. X. Parratt; P/O. R. V. Selle; Sgt. D. D. Todd; Sgt. I. I. Twistleton-Wykeham Fiennes; Flt. Sgt. J. A. Wilson.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. R. S. Anderson; Sgt. E. W. Andrews; Flt. Sgt. R. L. Armsby; F/O. J. H. S. Bebington; Sgt. J. W. Bills; Sgt. A. W. Blake; Act. F/O. C. O. Bloodworth; P/O. P. F. J. Bonham; Sgt. J. W. Bradley; Sgt. J. W. Butler; Sgt. T. A. Butterworth; P/O. V. C. H. Colbourne; Flt. Sgt. J. S. Cooper; P/O. K. W. Davies; P/O. A. E. Day; Sgt. J. Denham; Sgt. T. K. Downes; Sgt. I. L. Evans; Sgt. H. W. Fewkes; P/O. D. C. Firth; P/O. L. J. B. Foster; P/O. R. A. F. Frew; Sgt. H. C. Gardner; Flt. Sgt. A. T. Gooderham; Sgt. C. P. Greenhill; Sgt. A. S. Greenwood; Sgt. W. T. Holmes; P/O. G. D. G. Hudson; Sgt. S. A. Kent; Sgt. W. King; Sgt. M. G. Kipling; Sgt. F. A. Lamb; P/O. A. E. Lloyd; Sgt. R. S. A. McLarty; Sgt. S. R. McLeod; Sgt. P. C. G. Maflin; P/O. D. P. F. C. Mauchlen; Sgt. A. S. Maynard; Sqn. Ldr. S. A. Middleton, D.F.C.; P/O. H. Mohr-Bell; Sgt. J. A. Orton; F/O. J. R. B. Parsons; Sgt. D. G. F. Pexon; Sgt. W. Powell; Sgt. L. F. Redfern; Sgt. F. R. M. Rodmer; P/O. J. Rollinson; P/O. J. C. L. Ruck-Keene; Sgt. G. E. Smith; Sgt. D. F. Spindler; F/O. D. Stein; Act. Sqn. Ldr. R. T. Stubbs, D.F.C.; Sgt. J. M. Taylor; Act. Sqn. Ldr. K. H. Walsh; Sgt. B. W. Wareham; F/O. T. Wewege-Smith.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW REPORTED KILLED IN ACTION.—Sgt. R. D. Fletcher; Sgt. G. Hancock.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Sgt. S. Block; Sgt. H. G. S. Garnham; Sgt. E. M. Price; Flt. Sgt. M. C. Roberts.

WOUNDED OR INJURED IN ACTION.—F/O. E. T. Butcher.

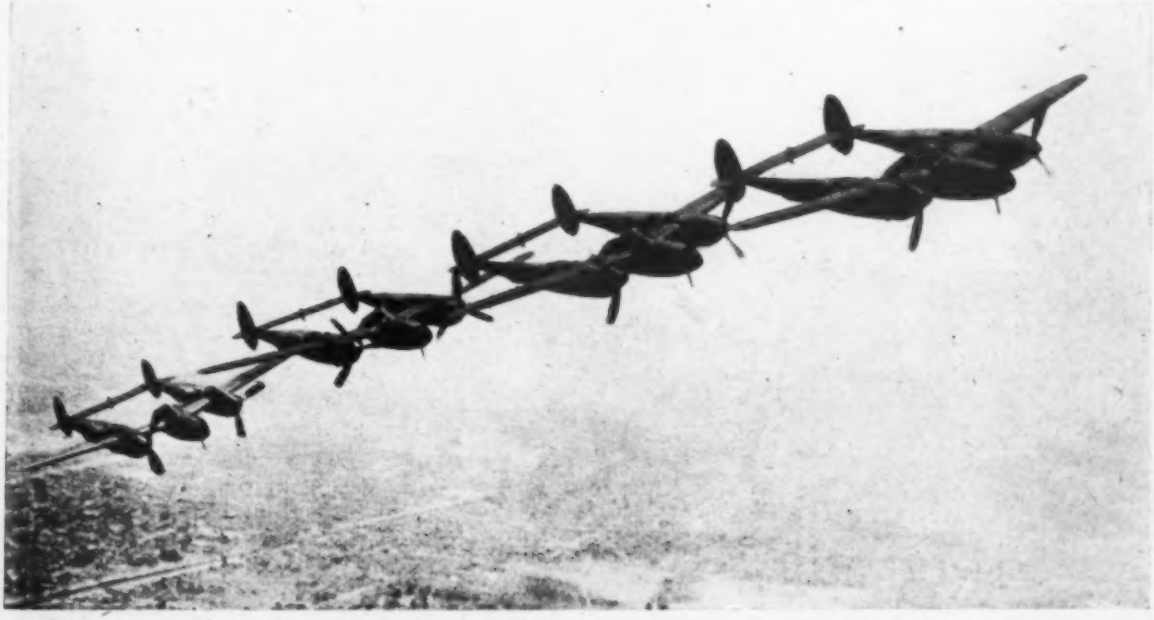
PREVIOUSLY REPORTED WOUNDED OR INJURED IN ACTION, NOW REPORTED DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. V. R. Baker.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. E. A. Bailey; Sgt. F. Davidson, D.F.M., Sgt. J. A. Larkin; Sgt. T. R. Mildon; Sgt. C. K. Ormston; Sgt. E. Owen; Sgt. C. J. Riley-Hawkins; Sgt. H. Taylor; P/O. H. Taylor; Sgt. J. H. Watkinson; Sgt. C. V. Williams; Sgt. G. Williams.

Warrant Officer Ivy L. Millett, W.A.A.F., wife of F/O. W. C. Millett, has been awarded the British Empire Medal.

MISSING.—Sgt. M. Addess; Sgt. D. Balmer; Sgt. A. H. D. Barton; Sgt. J. D. Beattie; Sgt. F. Bonser; Sgt. R. Brock; Sgt. D. R. Burn; Sgt. D. A. Cawthen; Sgt. R. F. Chisholm; Sgt. W. A. Collins; Sgt. A. T. P. Considine; Sgt. K. R. Cornford; Sgt. A. V. Cuthbert; Sgt. G. M. Footner; Sgt. J. Hanna; Sgt. H. S. Hardy; Sgt. F. Hartley; Flt. Sgt. R. J. Helsdon; Sgt. R. D. Howarth; Sgt. G. Lakeman; Sgt. B. A. T. Lane; Flt. Sgt. J. E. Lineham; Sgt. E. A. G. Lumsden; F/O. A. N. McClintock; Sgt. T. H. McGreevy; Sgt. J. A. M. Mackay; Sgt. D. J. Meikle; Sgt. J. B. Melvin; Sgt. D. R. I. Morgan; P/O. J. W. Murray; F/O. W. Muray; Sgt. N. J. Naylor; Sgt. C. W. Penny; P/O. R. H. Powell; Sgt. E. V. Pratt; Sgt. R. G. Richards; Sgt. J. J. McK. Rigley; P/O. H. P. Roblin; Sgt. F. D. N. Row; Sgt. B. Shepherd; Sgt. D. Smith; Sgt. F. G. Stoner; P/O. H. A. Sullivan; Flt. Sgt. J. W. D. Sykes; Sgt. K. J. Watson; Flt. Sgt. E. G. H. Waits; Act. Grp. Capt. E. B. Webb; Sgt. J. W. Wilkinson; F/O. G. B. Will; Sgt. S. Woodhead; F/O. R. P. Worthy.

KILLED ON ACTIVE SERVICE.—L.A/C. C. E. Arnold; P/O. C. J. R. Boyce; Sgt. F. A. Dann; A/C.2 W. Giblin; A/C.1 J. A. Gibson; Sqn. Ldr.



NOT SO COMPLICATED AS IT LOOKS: A formation of Lockheed twin-fuselage P.38s, known to the R.A.F. as the Lightning. Aircraft of this type are in service in Australia.

SERVICE AVIATION

E. C. Inglefield; P/O. W. R. Kelly; A/C.1 W. E. Richardson; Sgt. H. G. Stalker; L.A/C. R. A. Taylor.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Lt. R. F. Leavitt, D.F.C.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. P. N. Lloyd.

WOUNDED OR INJURED ON ACTIVE SERVICE.—L.A/C. G. G. McDonald.

DIED ON ACTIVE SERVICE.—F/O. T. E. Brammall; Act. Flt. Lt. H. S. Hodges; F/O. N. J. Jones; Cpl. V. F. Morris; A/C.1 R. Pringle; Cpl. G. H. Rowlinson; A/C.1 G. C. Thomas.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Flt. Lt. W. E. Bowden; Sgt. J. A. Drever; Sgt. C. Grimwood; Sgt. T. L. Kennea; Sgt. M. H. Knowles; Sgt. A. Levy; Sgt. A. F. Murrell; Rev. Sqn. Ldr. N. K. Nye; Sgt. R. C. Rawlings.

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—A/CW.2 M. Baldwin; A/CW.2 M. T. Gorman; A/CW.2 I. E. Jones; Asst. S/O. H. Patterson; A/CW.1 M. I. Philpott; Assist. S/O. C. L. Unwin.

Royal Australian Air Force

KILLED IN ACTION.—Sgt. A. W. Garrett.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. B. M. Geissmann; Sgt. B. T. Hoad; Sgt. R. H. Wilsen.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—A/C.1 J. C. Francis; L.A/C. N. Raine.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—P/O. J. Lea; Sgt. J. Logan.

MISSING, BELIEVED KILLED IN ACTION.—P/O. C. A. Harland; P/O. S. T. Manners.

MISSING.—Sgt. J. J. Eden; Sgt. C. A. Fletcher; Sgt. R. R. Frost; Sgt. L. S. Powell.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Sgt. F. S. Warren.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. E. G. Painter.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW REPORTED KILLED ON ACTIVE SERVICE.—Sgt. M. H. Wadham.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. R. G. Tregenza.

Royal Canadian Air Force

KILLED IN ACTION.—Flt. Sgt. J. P. B. R. Buckley; Sgt. K. L. Hardy; Sgt. M. L. Usher.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. J. M. Grant.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. G. K. Armstrong; P/O. D. W. Brubacker; Sgt. G. N. Bryan; Sgt. F. L. Capstick; Sgt. A. Harkness; Sgt. A. T. Hatton; Flt. Sgt. J. A. Jacobson; Sgt. F. T. James; Sgt. W. R. Lance; P/O. G. S. McDonald; Flt. Sgt. F. J. Menshek; Sgt. J. E. Mylrea; F/O. H. W. Oldham; Sgt. J. G. Park; Sgt. R. J. F. Perras; P/O. H. S. Ray; Sgt. V. Sature; Sgt. W. P. Thom; P/O. C. S. White.

WOUNDED OR INJURED IN ACTION.—P/O. H. G. Jollymour.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. S. D. Dean; Sgt. L. G. Murphy.

MISSING.—P/O. H. L. Cook; Sgt. A. K. Hamilton; Sgt. J. F. P. H. Lafreniere; Flt. Sgt. W. T. McEwan; Flt. Sgt. H. A. Neal.

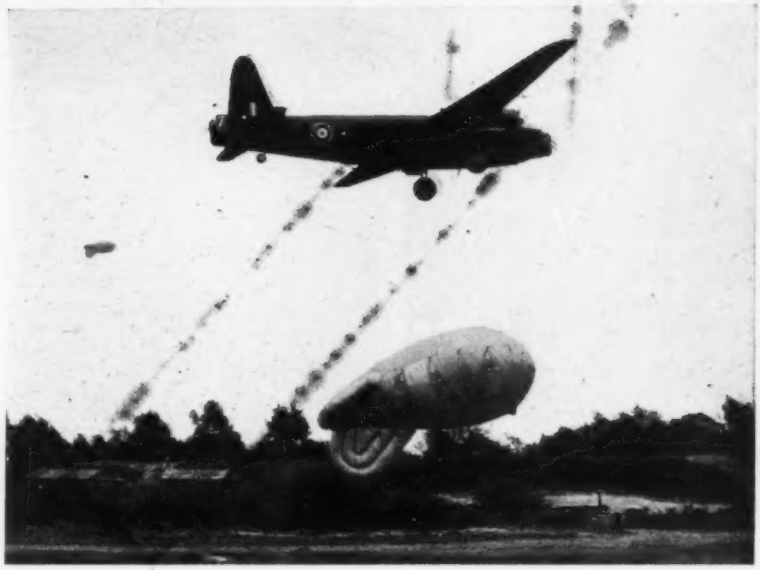
KILLED ON ACTIVE SERVICE.—P/O. H. J. Appel; Sgt. A. B. Keith; Sgt. V. L. Morris; Sgt. J. W. Scarff; Sgt. M. H. Smith; Sgt. W. B. M. Wilson.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. B. W. McFall.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. J. B. Spero.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. E. A. Smith.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. K. Westbrook.



DODGING THE STRINGS: The pilot of a Wellington takes off among kite balloons. That is not so difficult, but sometimes the approach is apt to be worrying.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. O. A. Matthews.

MISSING.—P/O. N. P. Morse; Flt. Sgt. G. H. Vogan.

KILLED ON ACTIVE SERVICE.—Sgt. J. J. Burke; Sgt. A. G. McNeil; P/O. J. M. Warnock.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW REPORTED KILLED ON ACTIVE SERVICE.—P/O. J. W. Thompson, D.F.C.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—P/O. D. H. Yeoman.

South African Air Force

WOUNDED OR INJURED IN ACTION.—Lt. W. Duff-Richardson.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Air. Cpl. J. M. Abrahams; Cpl. H. C. Liebenberg.

CANADIAN TERMINUS: A scene at the Ferry Command airport near Montreal. The variety of types waiting to be ferried across to this country is impressive.